July 7, 1970 H. C. WERNER 3,518,813

EXTENDED DISCHARGE SYSTEMS FOR ELECTROSTATIC PRECIPITATOPS

Filed Sept. 4, 1968

FIG. 1

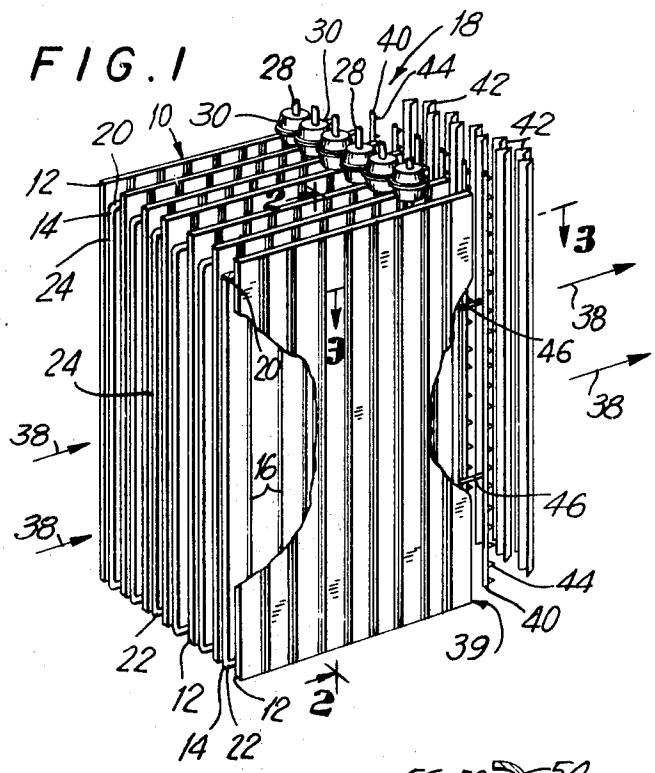


FIG. 2

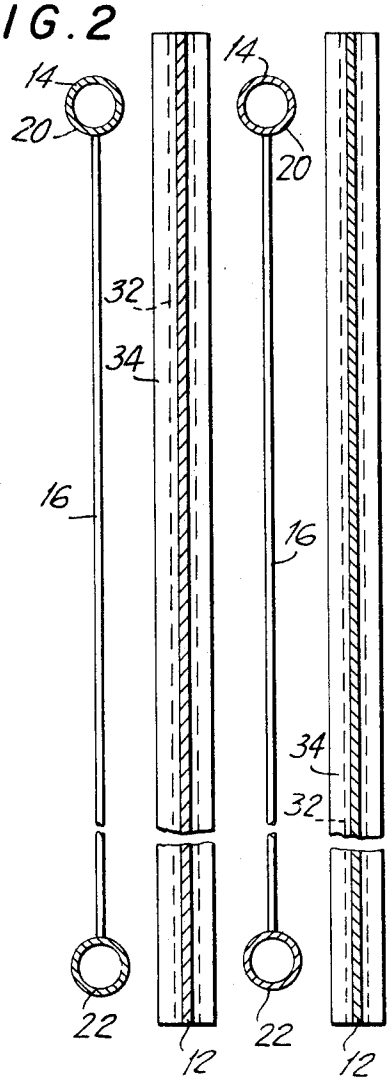


FIG. 4

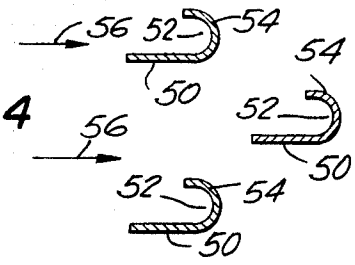
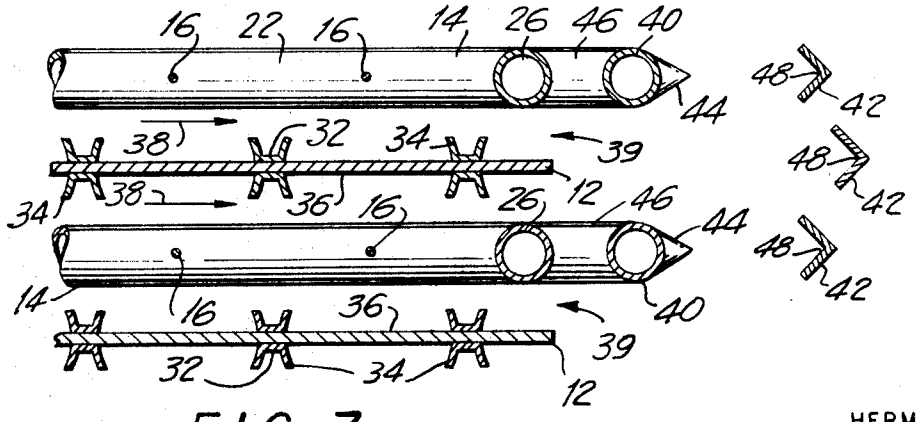


FIG. 3



INVENTOR.
HERMANN C. WERNER

BY

Blum, Moscovitz, Friedman, Blum & Kaplan
ATTORNEY

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EXTENDED DISCHARGE SYSTEMS FOR ELECTROSTATIC PRECIPITATORS

Hermann C. Werner, Ridgewood, N.J., assignor to Airetron Engineering Corporation, Midland Park, N.J., a corporation of New Jersey

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Int. Cl. B03c 3/08
U.S. Cl. 55—136 7 Claims

ABSTRACT OF THE DISCLOSURE

An extended discharge system for electrostatic precipitators including further discharge electrodes disposed downstream from the main electrostatic precipitator stack and further collection plates spaced downstream from said further discharge electrodes and adapted to receive and retain precipitant while permitting the continued flow thereby of the fluid from which the precipitant is being removed. The further discharge electrodes are preferably adapted to produce a directional electrostatic field extending substantially in the direction of flow of said fluid.

BACKGROUND OF THE INVENTION

This invention relates generally to electrostatic precipitators of the type wherein a plurality of discharge electrodes are interposed between a plurality of spaced collection plates. Such electrostatic precipitators are used for air pollution control, gas cleaning, separation and selective particle removal. Generally, the fluid containing the material to be precipitated flows, under positive or negative pressure, between the collection plates and past the discharge electrodes which are adapted to produce a corona and electrostatic field when a sufficiently high voltage is applied thereto. The voltage is preferably negative to produce a negative corona effect and ionization.

Both positive and negative ions are generated in the corona, the positive ions remaining on the negatively-charged discharge electrode, while the negative ions pass over to the grounded collection plate along the lines of force of the electrostatic field which extends therebetween. The particles to be precipitated intercept the negative ions, are charged thereby, and are attracted to the adjacent collection plate. The collection plates are generally provided with baffles, or other means to prevent the precipitant from being reentrained in the fluid due to the passage of the fluid past the collection plates. The fluid leaving the electrostatic precipitator moves on to recovery or exhaust.

Although electrostatic precipitators of the foregoing description are highly efficient, a minute amount of charged and neutral particles generally escapes from the downstream side of the stack of alternating collection plates and discharge electrodes. Such particles, either never reached the collection plates or were reentrained therefrom by the fluid passing thereby. These particles move with the fluid and experience has shown that the charged particles partially attached themselves to pipes and walls downstream of the collection plate area. By adding an extended discharge system combined with an additional dust collecting device downstream of the main electrostatic precipitator stack, the foregoing can be utilized for improvement of the electrostatic dust removal.

SUMMARY OF THE INVENTION

Generally speaking, in accordance with the invention, an extended discharge system for electrostatic precipitators of the type wherein a plurality of discharge electrodes are interposed between a plurality of spaced collector plates is provided. The extended discharge system includes a plurality of further discharge electrodes disposed downstream of said first-mentioned discharge electrodes in the path of the fluid from which material is to be precipitated, and a plurality of further collection plates spaced downsteram of said further discharge electrodes in the path of said fluid, said further collection plates being adapted to receive and retain precipitated material while permitting the continued flow of the fluid. The further discharge electrodes are adapted to produce a directional electrostatic field extending substantially in the direction of flow of the fluid and are formed with a plurality of sharp edges or points on the side thereof facing in the direction of the flow of said fluid while being substantially free from sharp edges or points on the other sides thereof. The further discharge electrodes are coupled to and supported by the frame supporting the main discharge electrodes, said coupling being conductive so that the main discharge electrodes and further discharge electrodes are electrically connected.

Accordingly, it is an object of this invention to provide an extended discharge system for electrostatic precipitators.

Another object of the invention is to increase the efficiency of electrostatic precipitators.

A further object of the invention is to provide an electrostatic precipitator where substantially all of the precipitant is collected by the various collection plates, so that the number of escaping particles is substantially lessened.

BRIEF DESCRIPTION OF THE DRAWING

For a fuller understanding of the invention, reference is had to the following descripion taken in connection with the accompanying drawing, in which:

FIG. 1 is a perspective view of a stack of alternating collection plates and frames carrying discharge electrodes. with portions broken away, in combination with an extended discharge system according to the invention;

FIG. 2 is a partial enlarged sectional view taken along lines 2—2 of FIG. 1;

FIG. 3 is a partial enlarged sectional view taken along lines 3—3 of FIG. 1; and

FIG. 4 is a cross-sectional view of an alternate embodiment of the further collection plates according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, the electrostatic precipitator shown includes a stack **10** consisting of alternating collection plates **12** and frames **14** carrying discharge electrodes **16**, and the extended discharge system **18** according to the invention.

The construction and operation of stack **10** is well known in the prior art. In one example of the construction thereof, as shown in the drawing, the collection plates **12** are equally spaced from each other in substantially parallel relation. Centrally disposed between collection plates **12** are frames **14** which are preferably formed from a plurality of lengths of pipe. Each frame consists of a top section **20**, a bottom section **22** and side sections **24** and **26**. Extending between top and bottom sections **20** and **22** and secured thereto are discharge electrodes **16**. The discharge electrodes shown are in the form of a plurality of spaced thin wire conductors. If desired, the wire conductors may be formed with sharp edges (star wire) or with spaced points extending therefrom to enhance the corona effect. Secured to the top section **20** of each frame are supports **28** formed from an electrically conducting material. Fixed to each support **28** is an insulator **30** adapted to be extend through and secured

against the casing (not shown) of the electrostatic precipitator so that the frames **14** may be supported on said casing while being electrically insulated therefrom. Supports **28** are connected to a source of high voltage (not shown) whereby the operative voltage may be provided to the discharge electrodes **16** for the production of an electrostatic field and corona thereat.

A plurality of spaced channel-shaped members **32** are secured to collection plates **12**. The outwardly curved walls **34** of members **32** extend into the space between adjacent collection plates and define between said members substantially turbulence free sections **36**. The members **32** extend substantially parallel to discharge electrodes **16** and are disposed on the collection plates so that at least one of said discharge electrodes faces each of said turbulence free sections. Collection plates **12** are preferably grounded.

In operation, the fluid, preferably a gas, containing the material to be precipitated flows in the direction of arrows **38** through stack **10**. The fluid flows between the spaced collection plates **12** past discharge electrodes **16**. Due to the action of the corona formed at discharge electrodes **16** and the electrostatic field extending between said discharge electrodes and collection plates, the precipitant collects in turbulence free sections **36** at collection plates **12**.

The foregoing detailed description of stack **10** is given by way of example and not by way of limitation. Collection plates **12**, frames **14** and discharge electrodes **16** may be of any desired design and configuration. Thus, the discharge electrode **16** may be disposed and formed as taught in my copending application Ser. No. 757,292, filed Sept. 4, 1968, entitled Electrostatic Precipitators and assigned to the assignee herein. The wire discharge electrodes may be stabilized by means of weights secured to their lower ends rather than by being secured to bottom section **22** of frame **14** as shown in the drawing. In addition, various means may be incorporated in collection plates **12** for retaining the precipitant collected thereon.

The extended discharge system **18** according to the invention is disposed at the downstream side **39** of stack **10**. Extended discharge system **18** consists of further discharge electrodes **40** spaced downstream from frame **14** and further collection plates **42** spaced downstream from said further discharge electrodes. Each discharge electrode **40** is formed with a plurality of spaced sharp points **44** extending therefrom on the side thereof facing in the direction of the flow of the fluid. These points **44** are adapted to produce a corona effect and a substantially directional electrostatic field extending in the direction of the flow of said fluid. Each of said further discharge electrodes **40** is supported by and electrically connected to side **26** of one of frames **14** by means of coupling members **46**. In this manner, the voltage applied through supports **28** is applied not only to discharge electrodes **16** but also to further discharge electrodes **40**, so that separate support and electrical distribution system is not required for the extended discharge system **18**. However, separate supports and connections to the voltage supply may be provided if desired.

In the embodiment shown in the drawing, coupling members **46** and discharge electrodes **40** are formed from lengths of pipe, points **44** being secured to one side of the further discharge electrodes. However, further discharge electrodes **40** need not be formed from lengths of pipe, but could be formed from a bar of metal or the like. In addition, the further discharge electrodes according to the invention are not limited to electrodes having sharp points **42** extending therefrom. A substantially directional corona effect may also be produced by sharp edges formed, for example, by cutting spaced notches on the side of further discharge electrodes **40** facing in the direction of flow of the fluid or by securing sharp ridges to said further discharge electrode side.

Further collection plates **42** are adapted to receive and retain such of the material to be precipitated as might have escaped the collection plates **12** of stack **10**, without obstructing the continued flow of the fluid. The further collection plates, as shown in FIGS. 1 and 3, are V-shaped and include pockets **48** wherein the precipitant is retained. The spacing between the individual further collection plates permits the continued flow of the fluid thereby and out of the electrostatic precipitator.

A second embodiment of the further collection plates according to the invention is shown in FIG. 4 wherein each of said further collection plates **50** are of a substantially fishhook shape. Each further collection plate **50** is also provided with a pocket **52** defined by a portion thereof **54** extending normally to the direction of flow of the fluid. Said fluid would flow in the direction of arrows **56**. The further collection plates may be of any geometric shape provided they are adapted to receive and retain the precipitated material while permitting the continued flow of the fluid thereby. The further collection plates are preferably grounded.

Further discharge electrodes **40** are preferably disposed spaced from and parallel to frames **14** and equidistant from adjacent collection plates **12**. In this position, they are in the path of the fluid discharged from the spaces between adjacent collection plates **12**. The further collection plates **42** are disposed in staggered lines so as to be in the path of substantially all of the fluid without obstructing its continued flow. Said further discharge electrodes are preferably disposed so that the pocket **48** or **52** of at least one of said further collection plates is disposed facing each of said further discharge electrodes and the sharp points **44** extending therefrom. Electrostatic precipitators frequently consist of several stages, each stage being similar in construction to stack **10**. The extended discharge system according to the invention may be interposed between the various stages as well as being placed downstream of the last stage.

The extended discharge system **18** according to the invention is specifically adapted to collect the small percentages of material to be precipitated which escapes from conventional electrostatic precipitators as represented by stack **10**. Particles of such material are generally charged to some extent. The extended discharge system **18** according to the invention further charges such particles and collects them at further collection plates **42**, thereby increasing the efficiency of the entire electrostatic precipitator. By designing the further discharge electrodes **40** to produce a substantially directional electrostatic field extending in the direction of flow of the fluid, any particles remaining in the fluid are specifically directed to further collection plates **42**. On the other hand, were the extended discharge electrodes adapted to produce an electrostatic field extending in all directions, as would be the case if they were formed from thin wire conductors, a larger portion of the particles might be directed toward and adhere to the side walls of the electrostatic precipitator casing since said further discharge electrodes are preferably disposed beyond the downstream side **39** of collection plates **12**.

It will thus be seen that the objects set forth above, and those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawing will be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. In combination with an electrostatic precipitator for the precipitation of materials from fluid having a plurality

of first discharge electrodes interposed in the regions between a plurality of spaced first collection plates, said first collection plates having an inlet side for the entry of said fluid and an outlet side spaced from said inlet side for the discharge of said fluid, said fluid flowing from said inlet to said outlet side between said collection plates past said first discharge electrodes, the improvement which comprises, a plurality of second collection plates spaced downstream from said first collection plates outlet side in the path of said fluid, said second collection plates being spaced from each other to permit the passage of said fluid thereby, each of said second collection plates including a portion extending transversely to said first collection plates outlet side and to the direction of flow of said fluid for retaining said precipitant; and second discharge electrodes interposed intermediate said first collection plates outlet side and said second collection plates in the path of said fluid.

2. An electrostatic precipitator as recited in claim **1**, wherein the spaces between adjacent first collection plates define fluid passageways terminating in outlets at said outlet side of said first collection plates, said second discharge electrodes being formed of longitudinally extending bars having sharp edges or points formed on the side thereof facing said transverse portions of said second collection plates, at least one of said discharge electrode bars being disposed adjacent to and extending substantially parallel to the outlet of each of said fluid passageways.

3. An electrostatic precipitator as recited in claim **1**, wherein said first and second discharge electrodes are maintained at substantially the same voltage.

4. An electrostatic precipitator as recited in claim **1**, including a plurality of supports interposed between said first collection plates for supporting said first discharge electrodes; and a plurality of coupling members extending between said second discharge electrodes and said supports for supporting said second discharge electrodes, said supports and coupling members being formed from electrically conducting material for the common energization of said first and second discharge electrodes.

5. An electrostatic precipitator as recited in claim **1**, wherein said second discharge electrodes are formed with a plurality of sharp edges or points on the side thereof facing said second collection plates.

6. An electrostatic precipitator as recited in claim **5**, wherein the other sides of said second discharge electrodes are substantially free from sharp edges or points.

7. An electrostatic precipitator for the precipitation of materials from fluids comprising a plurality of first spaced collection plates disposed in parallel overlapping relation, said first collection plates having an inlet side for the entry

of said fluid and an outlet side spaced from said inlet side for the discharge of said fluid; a tubular frame member interposed between each adjacent pair of said first collection plates; a plurality of first discharge electrodes mounted on said frame members in the space between said first collection plates, said fluid flowing from said inlet side to said outlet side between said first collection plates past said first discharge electrodes; a plurality of coupling means mounted on the side of said frame members adjacent said first collection plates outlet side, said coupling members projecting beyond said first collection plates outlet side; a plurality of second collection plates spaced downstream from said first collection plates outlet side in the path of said fluid, said second collection plates being spaced from each other to permit the passage of said fluid thereby, each of said second collection plates including a pocket-shaped portion extending transversely to said first collection plates outlet side, said pocket-shaped portions having the entrances thereof facing said first collection plates outlet side for retaining said precipitant; and second longitudinally extending discharge electrodes mounted on said coupling means intermediate said first collection plates outlet side and said second collection plates, at least one of said second discharge electrodes being adjacent to and extending parallel to the space between each adjacent pair of second collection plates, said second discharge electrodes being formed with sharp edges or points on the side thereof facing said second collection plates.

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DENNIS E. TALBERT, JR., Primary Examiner

U.S. Cl. X.R.

55—140, 151, 152, 154, 444