

Dec. 5, 1950

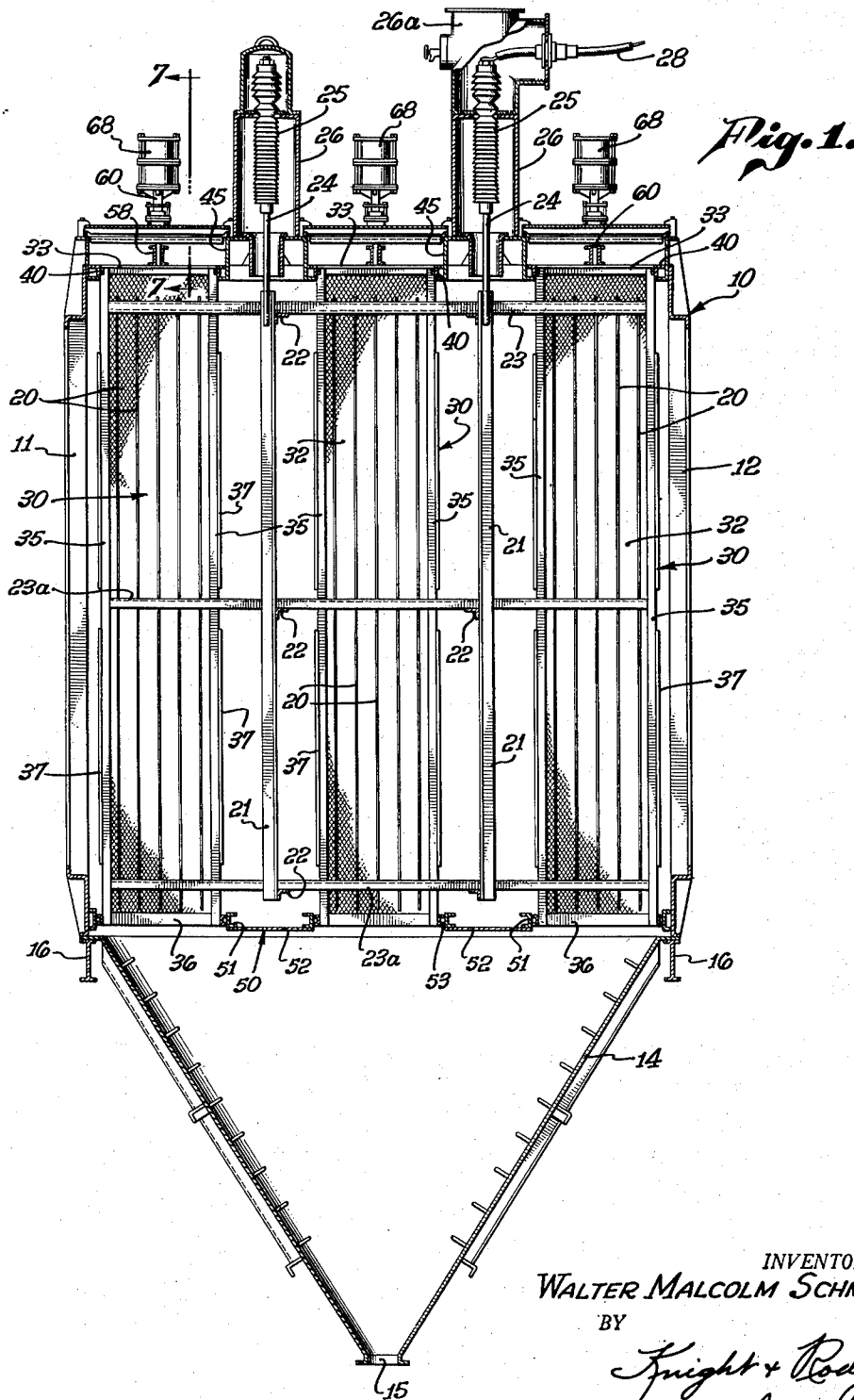
W. M. SCHMIDT

2,532,734

ELECTRODE CONSTRUCTION FOR ELECTRICAL PRECIPITATORS

Filed March 22, 1948

3 Sheets-Sheet 1



INVENTOR.
WALTER MALCOLM SCHMIDT,
BY
Knight + Rodgers
ATTORNEYS.

Dec. 5, 1950

W. M. SCHMIDT

2,532,734

ELECTRODE CONSTRUCTION FOR ELECTRICAL PRECIPITATORS

Filed March 22, 1948

3 Sheets-Sheet 2

Fig. 2.

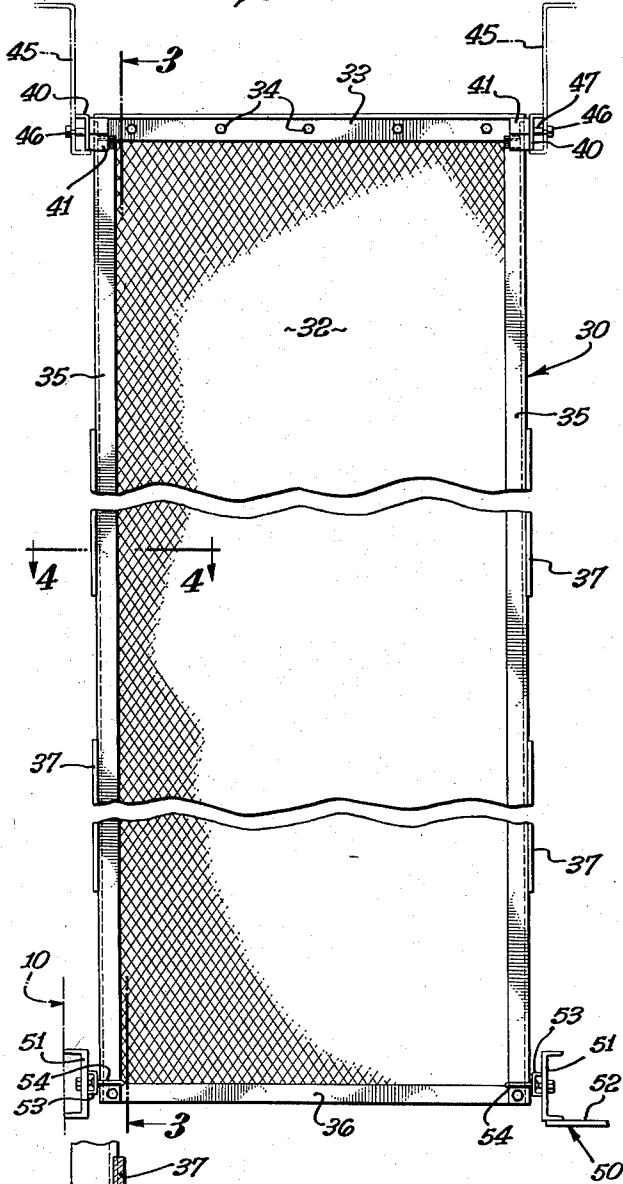


Fig. 4.

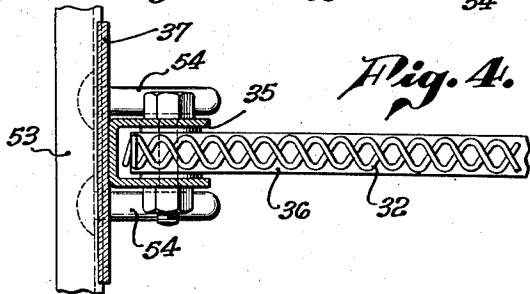
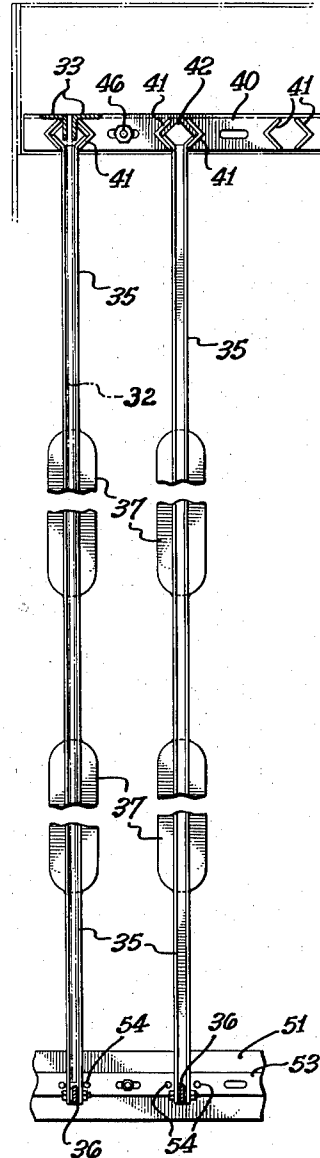


Fig. 3.



INVENTOR.
WALTER MALCOLM SCHMIDT,
BY
Knight & Rodgers
ATTORNEYS.

Dec. 5, 1950

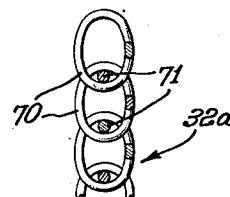
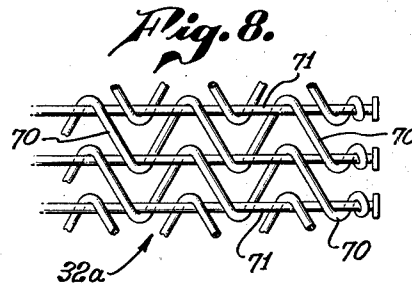
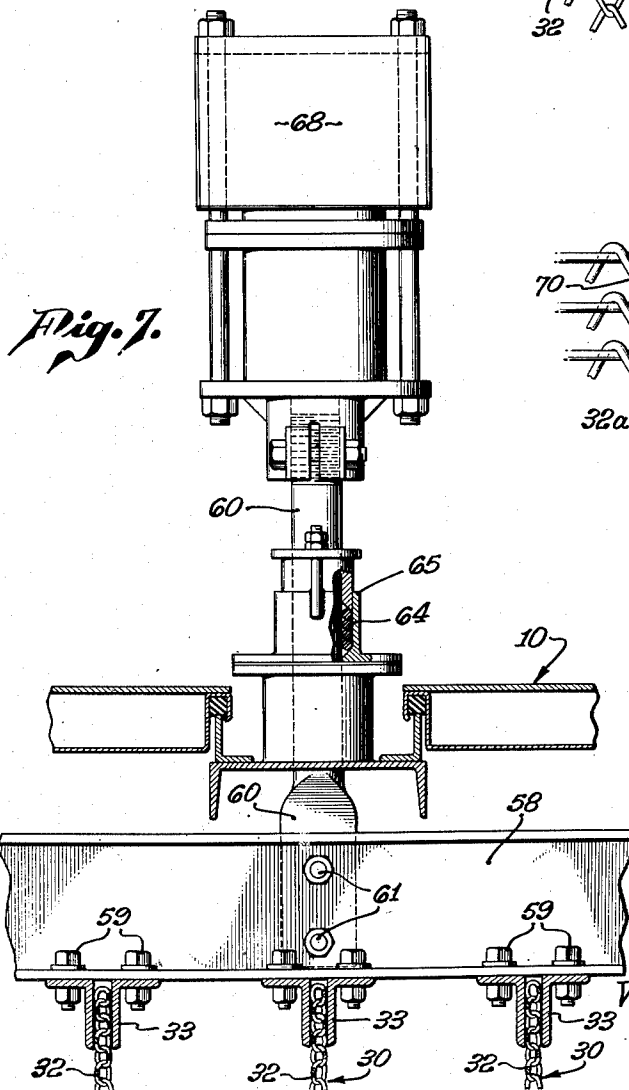
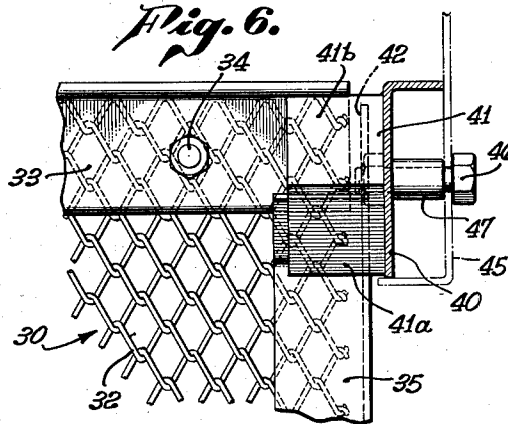
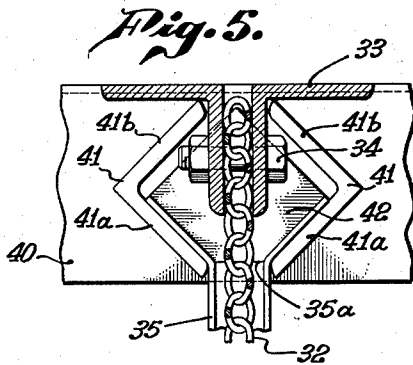
W. M. SCHMIDT

2,532,734

ELECTRODE CONSTRUCTION FOR ELECTRICAL PRECIPITATORS

Filed March 22, 1948

3 Sheets-Sheet 3



INVENTOR.
WALTER MALCOLM SCHMIDT,
BY
Spight & Rodgers
ATTORNEYS.

UNITED STATES PATENT OFFICE

2,532,734

ELECTRODE CONSTRUCTION FOR
ELECTRICAL PRECIPITATORSWalter Malcolm Schmidt, Los Angeles, Calif., as-
signor to Western Precipitation Corporation,
Los Angeles, Calif., a corporation of California

Application March 22, 1948, Serial No. 16,244

6 Claims. (Cl. 183-7)

1

The present invention relates generally to the electrical precipitation of suspended particles from gases and is particularly directed to improved collecting electrode structures for such electrical precipitators.

Briefly, the operation of electrical precipitation consists in passing gases containing suspended fine particles of either solid or liquid through an electric field in which the particles become electrically charged by attachment of electrons or ions and are then attracted to an electrically charged member upon which the charged particles are collected. It has been common practice to effect charging of the suspended particles by passing them between two opposed electrodes between which a high potential difference is maintained, one of the two electrodes being a discharge electrode at which there is silent or corona electrical discharge that ionizes the gas and causes the suspended particles to become charged with the same electrical sign as the discharge electrode. This is termed charging action.

In the "single stage" type of precipitator, the charged particles migrate under the influence of the electric field between the electrodes toward the other electrode which is a non-discharging electrode of extended surface, and collect or become precipitated upon the surface of that electrode, which is consequently termed the collecting electrode. In the "two stage" or "separated field" type of precipitator, the gas containing all or a substantial portion of the charged particles passes into a second or precipitating field, typically maintained between two opposed non-discharging electrodes, and under the influence of the precipitating field, the charged particles migrate to one of the electrodes between which the field is maintained and are deposited thereon. The latter electrode is likewise termed a collecting electrode. The novel collecting electrode structure of the present invention is hereinafter shown and described as being embodied in a precipitator of the "single stage" type but it will be understood that the invention is also applicable to the "two stage" or "separated field" type of precipitator. The application of the invention to the latter type of precipitator will be apparent to those skilled in the art from the description below.

In the following description and in the appended claims, the term "discharge electrodes" will be understood to designate an electrode which facilitates corona discharge therefrom, because it has a configuration that establishes a sufficiently high potential gradient at or near its

2

surface to create corona discharge before there is a disruptive discharge or spark-over. For this purpose, the discharge electrode usually takes the form of a member of small surface area, such as a small diameter wire or a rod provided with sharp edges or points; whereby there may be created in the immediate vicinity of the electrode a sufficiently high electric field intensity to cause ionization and corona discharge. The term "non-discharging electrode" will be understood to designate an electrode that minimizes or prevents corona discharge therefrom because it has a configuration that establishes a sufficiently low field concentration at or near its surface to suppress the corona discharge at elevated potentials lower than the voltage required for disruptive discharge or spark-over. For this purpose a non-discharging electrode is usually one of extended surface, substantially free from sharp corners or other parts of sharp surface curvature at all portions which are located within the electric field so as substantially to avoid ionization or corona discharge at that electrode. The electrode of the present invention falls within the category of non-discharging electrodes.

It is a general object of the present invention to devise a collecting electrode which effects a maximum economy in the construction of a precipitator. This is a particularly important feature because of the high initial cost of a precipitator installation. In greater detail, it is an object of the invention to devise a construction which permits a maximum of fabrication in the shop and requires a minimum of labor for crating and shipping the electrode structures as well as a minimum of labor in the field to erect the electrodes and place them in the precipitator installation.

It is also an object of this invention to devise an electrode construction which is versatile in design and easily adapted to different types and designs of precipitators. While this characteristic is desirable even in installations which are completely designed and built as a unit, it is of especial importance in the case of rebuilding a plant or converting it to an electrical precipitator installation from some other type of apparatus for dust collection. In the latter case, it is desirable to utilize as much of the existing structure as possible, and therefore it is desirable that the parts peculiar to an electrical precipitator be readily adaptable to different designs.

It is also an important object of the invention to provide a collecting electrode that is easy to rap and keep clean. Dust precipitated or col-

lected upon the collecting electrode usually adheres to the electrode to a greater or lesser extent and must be removed at frequent intervals in order to maintain the high efficiency of the precipitator since the accumulation of dust upon the electrode changes the electrical properties of the system. Since the typical electrical precipitator installation is designed for continuous operation, or substantially so, it is necessary to clean the electrode effectively in a minimum length of time, perhaps either while the gas is still flowing or while the gas stream has been only momentarily diverted from the particular electrode being cleaned. Usually cleaning the electrodes is accomplished by striking them by means of a hammer; and it is desirable that the electrode structure be such that the shock of the rapper be transmitted throughout the entire electrode to jar loose the accumulated dust deposit.

The above and other objects of this invention have been attained by providing a collecting electrode which comprises a suspended flexible sheet-like member. The support for the flexible member comprises in part a rigid hanger extending transversely across the top edge of the flexible member and resting upon fixed supporting elements. Guides or positioning means are provided for the electrode, which in a preferred form are vertically extending members located one at each vertical edge of the flexible member, to restrain the latter against undue horizontal movement. The flexible member preferably comprises a plurality of generally spiral or helicoform wire elements movably interconnected or loosely interwoven with other similar elements to leave relatively large openings between the wires, the plurality of wire elements forming a sheet-like member that is supported at its upper end and hangs in a substantially vertical plane within the side guides. The sheet-like member is especially flexible in a transverse plane since the several wire elements are loosely interwoven and movable with respect to each other.

Fixed support means for the hanger and guides are preferably located at the sides of the flexible member; and at each side typically comprises a pair of spaced elements upon which a guide rests to be supported at its upper end and which receive the guide by horizontal movement in one direction. The support means also support the hanger and the attached sheet-like member in a position such that the hanger confines the guide against horizontal movement in the reverse direction which would tend to unseat the guide from the fixed support means.

How the above objects and advantages of my invention, as well as others not specifically mentioned herein, are attained will be more readily understood by reference to the following description and the annexed drawings, in which:

Fig. 1 is a vertical cross section through a typical electrical precipitator showing the collecting electrodes of my invention installed therein, the gas flow through the precipitator being in a direction parallel to the plane of the figure;

Fig. 2 is an enlarged elevation of a collecting electrode structure according to my invention and supporting means therefor, together with certain adjacent parts of the housing structure;

Fig. 3 is a vertical section on line 3—3 of Fig. 2 through a typical collecting electrode, showing the supporting means in elevation, certain of the parts being omitted to clarify the drawing;

Fig. 4 is a further enlarged fragmentary horizontal cross section on line 4—4 of Fig. 2;

Fig. 5 is a further enlarged fragmentary front view of the support means for an electrode and the upper end of the electrode, viewed as in Fig. 3;

Fig. 6 is a further enlarged fragmentary elevation of a portion of the upper end of a collecting electrode and the supporting means therefor;

Fig. 7 is an enlarged vertical cross section through the upper end of several collecting electrodes, as on line 7—7 of Fig. 1, showing the attachment thereto of a rapper; and

Figs. 8 and 9 are, respectively, a fragmentary elevation and a vertical cross section of a variation of link arrangement for the flexible sheet.

The precipitator is ordinarily enclosed within a housing or shell which is generally designated at 10. The shell is here shown as being made of metal, but it may be constructed of masonry or other suitable material. The shell is provided at one end with a gas inlet opening 11 and at the opposite end with a gas outlet opening 12 which communicate with any suitable type of ducts, not shown in the drawings, for conveying a dust-laden stream of gas to and from the precipitator shell. Shell 10 is generally rectangular in cross section, except that the bottom is formed into a hopper 14 into which dust falls from the collecting electrodes. The dust is withdrawn from hopper 14 and shell 10, either continuously or intermittently as may be required, through bottom opening 15 which is connected to any suitable type of dust-conveying conduit, not shown. Shell 10 is ordinarily supported by connection to a building or a structural framework, the details of which constitute no part of the present invention and are therefore not illustrated herein; but as typical of such supporting framework, the shell may be supported upon I-beams 16. Through this supporting framework, shell 10 and all metallic parts which are electrically connected thereto are ordinarily grounded and are so maintained at ground or low potential.

The high tension discharge electrode assembly is shown in side elevation in Fig. 1, and comprises a structural framework upon which a plurality of discharge electrodes 20 is mounted. This frame in part resembles a cage and consists of vertically extending posts 21 to each of which are attached three horizontal members 22 which extend transversely of the direction of gas flow. The members 21 and 22 are ordinarily structural channels or angles, but may be of any suitable shape. Horizontal members 22 support a plurality of other horizontal members, 23 and 23a. To a top horizontal member 23 there is attached a plurality of individual discharge electrodes 20 so arranged that they are all in a common vertical plane. The lower horizontal members 23a guide or position the discharge electrodes. Individual electrodes 20 may be fine wires of small diameter or rods of polygonal cross section having relatively sharp corners at which corona discharge takes place.

The frame carrying discharge electrodes 20 is suspended from hanger rods 24 connected to the upper ends of posts 21 and passing upwardly through the top wall of shell 10. Each hanger rod 24 passes through an insulator 25 which is located within housing 26 that is divided into upper and lower sections. Each insulator 25 is

supported at a point intermediate its ends on the top wall of the lower section of housing 26, the connection at this point being gas tight. Thus the interior of the lower section of housing 26 communicates with the interior of shell 10 but not with the upper section of the insulator housing. The upper section of one or more of insulator housings 26 is made as indicated at 26a in Fig. 1 to receive a high tension wire 28 which is connected to the upper end of a hanger rod 24 where it projects above insulator 25. By means of lead-in 28, electrical energy at a high voltage is applied to the high tension discharge electrodes from any suitable source, not shown.

As mentioned above, electrodes 20 shown in Fig. 1 as suspended from horizontal member 23 are arranged in a row in a common vertical plane which extends parallel to the direction of gas flow. In order to handle a large volume of gas in a precipitator, a plurality of such rows are usually arranged side-by-side in parallel planes spaced apart in a direction perpendicular to the plane of Fig. 1. The horizontal members 23 and 23a for such other rows and the electrodes 20 supported thereby are similar in all respects to the structure illustrated in Fig. 1 and are carried by transverse members 22; and if the electrode supporting framework is large enough, additional hanger rods 24 and insulators are provided, ordinarily a total of four being sufficient unless the load is very heavy. The added insulator assemblies may conform to the construction shown at the left of Fig. 1. The arrangement of opposing electrodes in rows alternating between discharge and non-discharging electrodes with gas flow parallel to the extent of the rows is conventional practice in the art.

As will be noticed by reference to Fig. 1, the high tension electrodes are arranged in groups, and opposing each of these groups of electrodes is a collecting electrode, generally designated at 30, of the non-discharging type. With the arrangement shown in Fig. 1, there are three such collecting electrodes 30 disposed in one row in a common vertical plane parallel to the vertical plane of a row of discharge electrodes 20. The details of construction of these collecting electrodes are shown more particularly in Figs. 2 et seq.

As may be seen in Fig. 2, each complete collecting electrode structure comprises a flexible sheet-like member 32 which is the electrode proper and is supported at its upper end by transversely extending hanger 33 that is fastened to sheet 32 by any suitable means, as bolts 34. The flexible sheet-like member 32 is like a wire mesh screen, being composed of a plurality of helicoform wire elements which are flexibly or movably interconnected, as by being loosely interwoven with each other. The openings between the wires are relatively large compared with the wire, as may be seen in Fig. 6. It is quite satisfactory that the least dimension of each opening between the wires be several times the diameter of the wires themselves. For example a wire of approximately .1" diameter and an opening of about $\frac{3}{8}$ " are satisfactory dimensions under most conditions. A smaller opening unnecessarily increases the weight of the electrode without increasing its efficiency; and there is a decrease in the efficiency of the electrode if the size of the opening is too great.

The several wire elements of the electrode sheet are described as helicoform since, although they may be true circular spirals, it is preferable that

they actually be a somewhat flattened spiral when viewed endwise, as may be seen in Fig. 5, as this change in shape from a true circle has the effect of reducing the thickness of the sheet and increasing its vertical dimension, and consequently the area of the sheet, for a given weight. The axes of these helicoform wire elements are parallel to each other and are horizontal or substantially so. In the form of screen shown in Figs. 5 and 6, the wire elements are each loosely interwoven with a similar element above and below it. There being no rigid connection between two interlocking spirals, the spirals are free to swing with respect to each other in a transverse plane; and consequently the sheet is extremely flexible in a transverse vertical plane, which is a plane perpendicular to the plane of Fig. 2 when the sheet is suspended. At the same time, the sheet as a whole has relatively little flexibility in a transverse horizontal plane perpendicular to the plane of Fig. 2 and even less flexibility in the plane of the drawing. This flexibility of the sheet-like member taken as a whole, comes about largely because of the nature of the interconnections between the helical elements composing the sheet, because the flexibility or resiliency of each individual element is roughly the same in any direction, although it may differ somewhat in various directions depending upon the amount of flattening of the spiral.

Hanger 33 from which sheet 32 is suspended may take any convenient form, but is here shown as being composed of a pair of angles placed back to back with sheet 32 clamped between the two parallel legs of the angles. Hanger 33 extends to the vertical edges of sheet 32 at each end.

Sheet 32 is confined at each of its vertical edges by guide or positioning means that engages the sheet below the top hanger, and preferably is channel-shaped guide member 35, shown in cross section in Fig. 4. Sheet 32 is not attached to channel 35 nor is it clamped therein, but there is sufficient clearance all around the sheet to enable the sheet to slide or vibrate freely within the channel. However, guides 35 impart a desirable degree of rigidity to the electrode structure and prevent sheet 32 from swinging freely toward and away from electrodes 20. Electrode sheet 32 normally hangs straight and vertically under its own weight, but it is desirable that guides be provided in order to constrain the electrode against undue horizontal movement, since any substantial change in the spacing between electrode 32 and electrodes 20 is to be avoided. In order to add to the rigidity of the electrode structure as a whole, the two side channel guides 35 may be loosely connected at their lower ends by cross bar 36.

In order to improve gas distribution and flow through the precipitator, each guide 35 is provided with baffles 37 which are flat, vertically extending plates attached to the outer face of channels 35. The use of such gas baffles is entirely optional but serves to shield the surface of collecting electrode 32 to some extent from the gas stream. As explained above and shown in Fig. 3, the precipitator consists of a series of alternating discharge electrode assemblies and collecting electrode structures arranged side-by-side in vertical planes, as shown in Fig. 1; and gas flow between each two collecting electrodes is equalized to some extent by baffles 37, since they prevent the bulk of the gas stream from flowing through the central portion of the precipitator, where resistance to flow is at a minimum. The baffle at

each side of the channel is made in two sections attached in the positions shown rather than as a single continuous baffle throughout the entire length of the channel in order to provide the necessary electrical clearance between the collecting electrode structure and the supporting framework for the discharge electrodes which is at high potential.

The fixed supporting means for the complete collecting electrode structure includes a horizontally extending angle member 40 upon the outer vertical face of which is mounted a pair of brackets 41. The two angle brackets 41 extend horizontally out from the face of the member 40 and are arranged facing each other, but spaced apart, as may be seen best in Figs. 3 and 5. A plurality of pairs of such brackets 41 are arranged at regular intervals along angle 40 to support successive electrode structures 30, as may be seen from Fig. 3. Considering for a moment only the lower legs 41a of brackets 41, it will be seen that these legs present a pair of downwardly converging and upwardly disposed faces. A guide 35 is prepared to be supported upon these faces by flaring outwardly the upward ends of the sides of the channel, in the manner shown in Fig. 5, so that the flared sides of the channel guide rest upon the upwardly disposed faces of elements 41a. In preparing the upper end of guide 35, the back of the channel is cut away at 35a above the bend in the sides, and plate 42, approximately square in shape, is welded to the channel guide along the line 35a, and also to the flared sides of the channel. In this way plate 42 braces the flared sides of guide 35 to hold them apart in the proper position.

Each guide 35 is hung upon brackets 41 by moving the upper end of the guide horizontally into the space between the two brackets 41 and allowing the guide to drop downwardly until its flared sides come to rest upon the downwardly converging upper faces of bracket elements 41a. Brackets 41, without any guide in them are shown at the extreme right in Fig. 3, while the brackets with a guide only supported on them are shown at the center of Fig. 3. This spacing between brackets 41 is such as to take guide 35 with slight clearance.

The upper legs 41b of angle brackets 41 act as holddown members to engage plate 42 and prevent channel guide 35 from being displaced upwardly from the supporting means. Elements 41b also engage directly hanger 33. Thus hanger 33 rests upon the top of brackets 41 allowing the mesh sheet 32 to pass downwardly between brackets 41 and into the channel guide at each vertical edge of the sheet. Although each leg 41a and 41b can be made as a physically separate member if desired, it is preferred for obvious reasons to make them in pairs as a single bracket 41.

As shown in Fig. 2, the supporting means for the vertical guide and hanger 33 is similar at each side of electrode structure 30. The horizontal length of hanger 33 is such that it slides down easily with ample clearance between the two angles 40 at either side of electrode 30, but hanger 33 is long enough that it cannot be displaced from a supporting bracket 41 merely by longitudinal movement. As may be seen in Fig. 6 the upper end of each vertical guide 35 as represented by plate 42 is between the end of hanger 33 and the outer vertical face of angle 40. In this way the guide is held securely against horizontal movement which would displace it from supporting brackets 41, i. e., horizontal movement in the

reverse direction to that which is used to seat the guide on the supporting brackets.

Each angle 40 is supported upon a bottom flange on an inverted channel 45 which extends transversely across the upper portion of the precipitator housing 10 and forms a part thereof, as shown in Fig. 1. Angles 40 are removably held in place by bolts 46 which carry spacers 47 that maintain the proper distance between the vertically extending portions of angle 40 and channel 45.

At the bottom of shell 10, are horizontally extending braces 50 which are located directly beneath channels 45, as may be seen in Fig. 1. Each brace 50 comprises a pair of horizontally extending channels 51 interconnected by lattice bars 52. Lattice bars 52 are preferred to plates in order that precipitated dust does not pile up on top of the braces. Braces 50 carry on their side faces channels 53, and are spaced apart horizontally the proper distance to receive between channels 53 the lower ends of electrodes 30, as shown in Fig. 2. Horizontally extending pins 54 are mounted on channels 53 in pairs, as shown in Fig. 3. The lower end of each guide fits between a pair of pins 54 and is positioned thereby to keep the guides parallel to each other and to the discharge electrodes. Guides 35 cannot move toward each other at their lower ends because of bar 52; and so pins 54 and channels 53 provide positioning means for holding the lower ends of the guides against horizontal movement but still permit the guides to move vertically.

There is shown in detail in Fig. 7 a typical construction whereby the collecting electrodes may be rapped and the accumulated dust jarred loose. A pair of channels 58 are placed back-to-back and extend transversely across the top of a number of electrodes 30. The channels 58 rest upon hangers 33 and are firmly bolted thereto by bolts 59. A vertical rod 60 is bolted to channels 58 at 61 and passes upwardly through shell 10. A gas-tight fit where rod 60 leaves the shell is obtained by placing packing 64 between rod 60 and sleeve 65 surrounding rod 60.

Rapper 68 is mounted upon the upper end of rod 60, and may be any one of a number of suitable types of rappers. The rapper 68 herein shown is of the pneumatic type and comprises an internal hammer (not shown) which is intermittently driven against an anvil by air pressure to create a shock which is transmitted by rod 60 and channels 58 to hangers 33 and flexible sheets 32. The shock is sufficiently violent that the vibration set up in the electrodes jars loose the accumulated dust on the collecting electrodes and the dust falls down into hopper 14.

In the particular arrangement shown in Fig. 7, the hammer in rapper 68 strikes an upwardly directed blow. As a consequence the shock wave transmitted to the flexible sheets 32 travels vertically or in a direction transversely to the general extent of the individual wire elements in each electrode 32. This causes each of the wire elements to be moved relative to adjacent elements, and this relative movement of the elements is very effective in breaking loose the dust accumulations. Since the flexible member 32 is not attached to guides 35 or cross bar 36, the minimum amount of weight is lifted and vibrated by the rapping mechanism, and the flexible sheet is free to move independently of the constraining guides around its border. At the same time, by virtue of the manner in which the guides and hanger are locked in the supporting brackets 41,

guides 35 are securely held against any movement which would displace them from their support during rapping.

It will be apparent from the foregoing description of the present invention, that the construction readily lends itself to a maximum of shop labor and a minimum of field labor for erection. The wire mesh sheets 32 can be cut to size in the shop and the hangers 33 bolted at one end. Each electrode can then be shipped by using the hanger as a core upon which to roll the flexible sheet of the electrode, thus making a package which is easily handled and crated and which is not subject to being easily damaged in shipment, as is the case with plates or other rigid members which have a surface area comparable to that afforded by the wire mesh curtain when it is in place in the precipitator.

The side guides 35 can be completely shop fabricated, and need no bolting or welding to hang them in place, except for attaching the cross bar 36 to each pair of channel guides.

Erection of the electrodes is particularly simple since, after hanging the two channels in place on brackets 41, the lower end of sheet 32 is inserted in the guides, and the electrode slides downwardly between the guides into place. This can be done as the electrode is unrolled from around hanger 33, assuming that it has been rolled for shipment as described above. As the flexible sheet slides downwardly in the side guides, hanger 33 drops into place, completing the structure and by its own weight securing itself in place.

The addition of the rapping mechanism is easy since the cross channels 58 are merely laid upon the tops of hangers 33 and bolted thereto.

It will also be evident from the foregoing description that this electrode construction is very easily adapted to precipitator housings of various sizes and shapes and can be used equally well with precipitators which are completely designed and built as a unit or those in which existing structures are used for the shell and only the electrodes are installed.

Although there is shown in Figs. 5 and 6 a form of woven wire mesh in which the helicoform elements are interwoven with each other it will be apparent that the same physical characteristics and advantageous results are obtained if the sheet 32 is made of the same helicoform elements which are loosely interconnected with each other by means which permit them to move freely with respect to one another. A sheet 32a of this type is illustrated in Figs. 8 and 9 in which the helicoform elements 70 are interconnected by means of transversely extending rods 71. Since there is no weld or cement or other material forming a rigid joint at the connection of two of these elements, it will be seen that the modified form of wire mesh illustrated in Figs. 8 and 9 may be used in place of that described earlier.

Having described a preferred embodiment of the present invention, it will be readily appreciated that various changes in the construction and detailed arrangement of parts may be made by persons skilled in the art without departing from the spirit and scope of my invention; and consequently it is to be understood that the foregoing description is considered as being illustrative of, rather than limited upon, the appended claims.

I claim:

1. A collecting electrode structure for an electrical precipitator comprising: a flexible sheet-like member; a rigid hanger attached across the top edge of the flexible member and adapted to

suspend the flexible member; a vertically extending guide at each vertical edge of the flexible member loosely restraining the flexible member against horizontal movement but permitting relative vertical movement; and supporting means for supporting the guides independently of the hanger.

2. A collecting electrode structure for an electrical precipitator comprising a flexible sheet-like member; a rigid hanger attached across the top edge of the flexible member; a U-shaped vertically extending guide at each vertical edge of the flexible member loosely restraining the flexible member against horizontal movement; and a fixed support means for the hanger and guide located at each side of the flexible member, the guide and hanger being independently supported in said support means.

3. A collecting electrode structure for an electrical precipitator comprising a flexible sheet-like member; a rigid hanger attached across the top edge of the flexible member; a U-shaped vertically extending guide at each vertical edge of the flexible member loosely restraining the flexible member against horizontal movement; and a fixed support means for the hanger and guide located at each side of the flexible member, comprising supporting elements adapted to receive the upper end of the guide by horizontal movement in one direction and to support the hanger in a position to confine said upper end of the guide against horizontal movement in a reverse direction.

4. A collecting electrode structure for an electrical precipitator comprising a flexible sheet-like member; a rigid hanger attached across the top edge of the flexible member; a U-shaped vertically extending guide at each vertical edge of the flexible sheet loosely restraining the flexible member against horizontal movement, the sides of the guide being flared outwardly at the top end; and fixed support means for the hanger and guide located at each side of the flexible member, comprising a pair of spaced elements having upwardly disposed and downwardly converging faces on which the flared sides of the guide rest, and second pair of spaced elements above the first pair for supporting the hanger with the flexible member passing downwardly between both said pairs of elements.

5. A collecting electrode structure for an electrical precipitator comprising a flexible sheet-like member; a rigid hanger attached across the top edge of the flexible member; a U-shaped vertically extending guide at each vertical edge of the flexible sheet loosely restraining the flexible member against horizontal movement, the sides of the guide being flared outwardly at the top end; and a fixed support means for the hanger and guide located at each side of the flexible member; comprising a pair of spaced facing angle brackets the lower legs of which provide downwardly converging faces on which the flared sides of the guide rest, and the upper legs of which brackets support the hanger in a position to hold the guide in place on the brackets.

6. A collecting electrode structure for an electrical precipitator comprising a flexible sheet-like member; a rigid hanger attached across the top edge of the flexible member; a U-shaped vertically extending guide at each vertical edge of the flexible sheet loosely restraining the flexible member against horizontal movement; fixed support means for the hanger and guide located at each side of the flexible member, comprising sup-

11

porting elements adapted to receive the upper end of the guide by horizontal movement in one direction and to support the hanger in a position to confine said upper end of the glide against horizontal movement in a reverse direction; and positioning means engaging each guide near the lower end to position the guide at its lower end and hold it against horizontal movement while permitting vertical movement relative thereto.

WALTER MALCOLM SCHMIDT.

5

10

12

REFERENCES CITED

The following references are of record in the file of this patent:

FOREIGN PATENTS

Number	Country	Date
337,490	Germany -----	June 9, 1921
459,808	Germany -----	May 16, 1928
747,904	France -----	Apr. 4, 1933