H. F. FISHER.

SELF CLEANING ELECTRIC PRECIPITATOR.

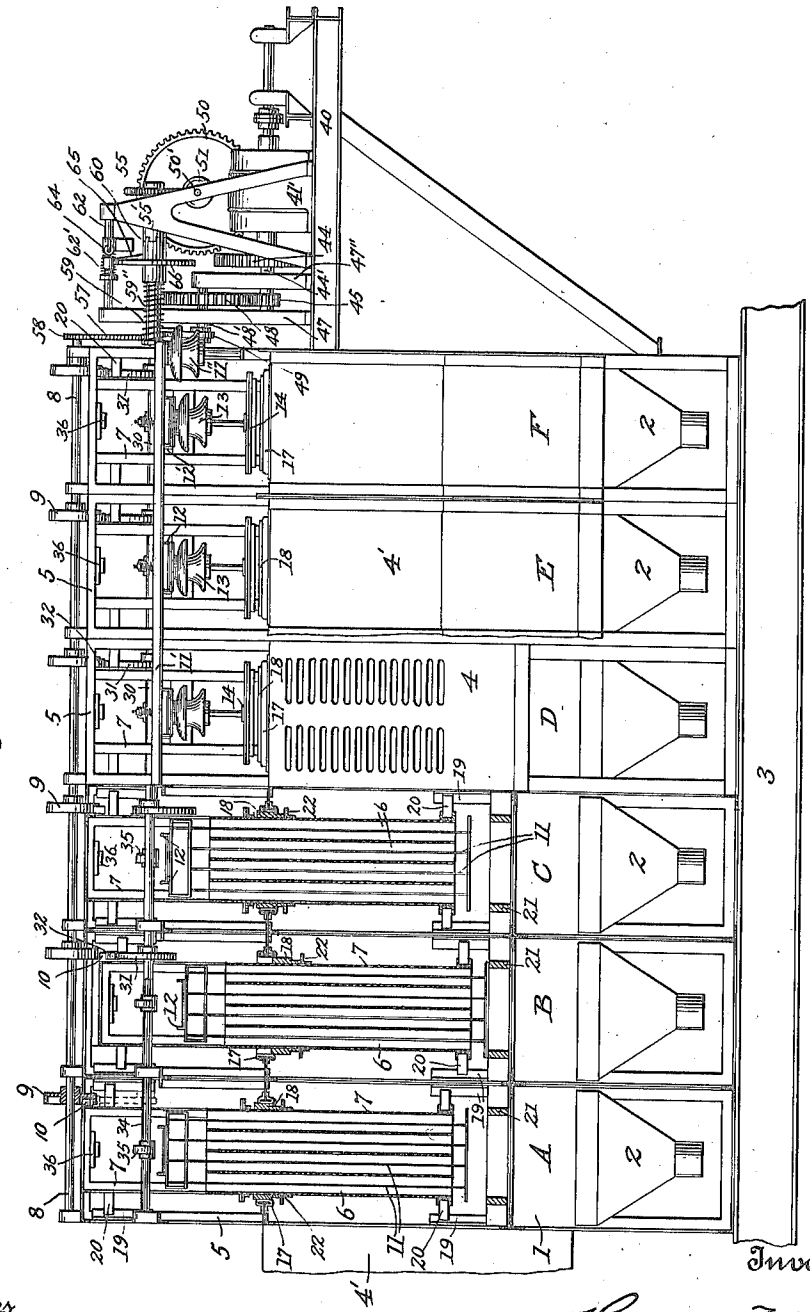
APPLICATION FILED NOV. 26, 1919.

1,433,266.

Patented Oct. 24, 1922.

5 SHEETS—SHEET 1.

Fig. 1.



Witnesses
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5 SHEETS—SHEET 2.

Fig. 5.

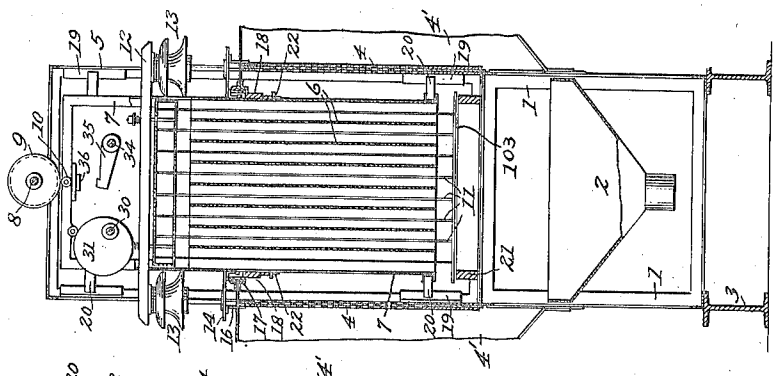


Fig. 4.

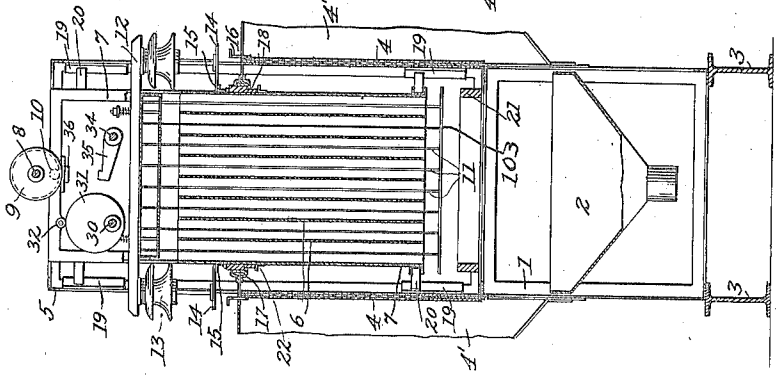
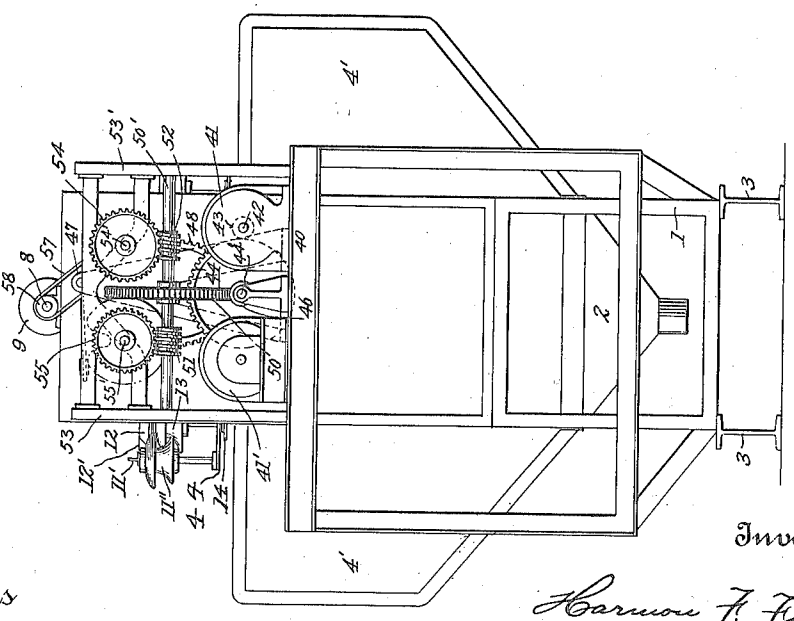


Fig. 2.



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5 SHEETS—SHEET 3.

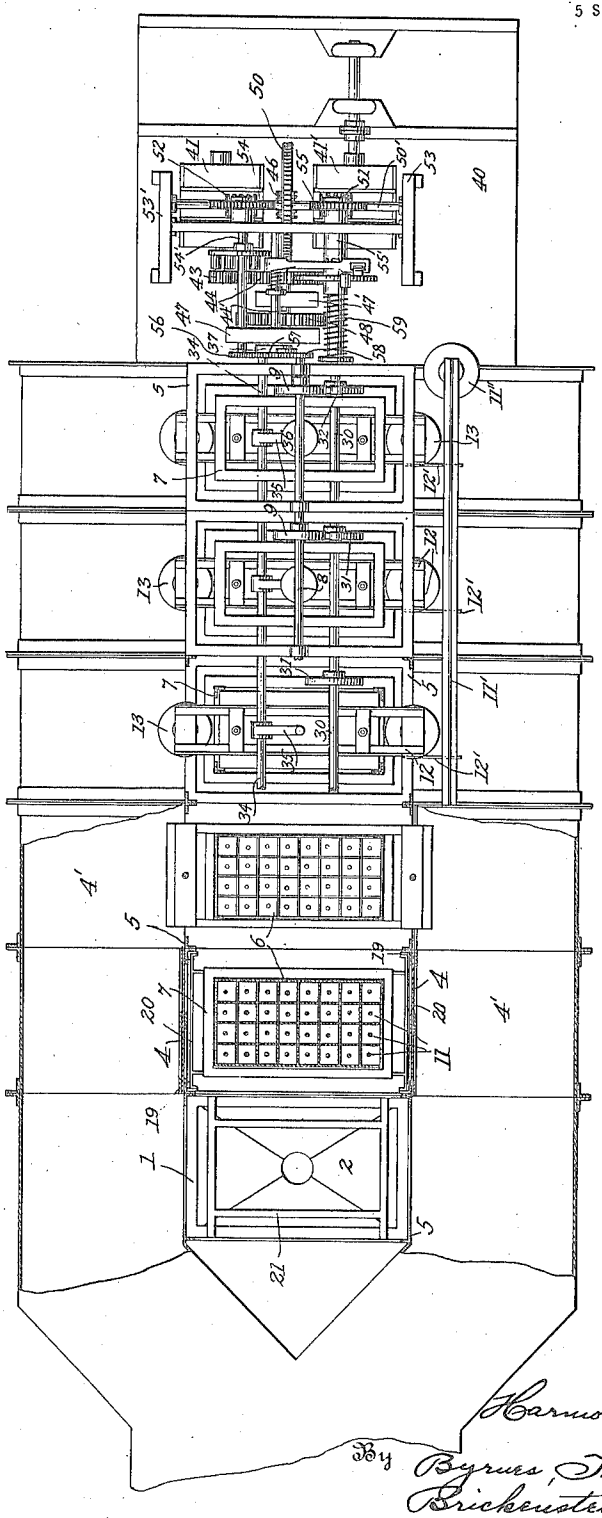


Fig. 3.

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5 SHEETS—SHEET 4.

Fig. 6.

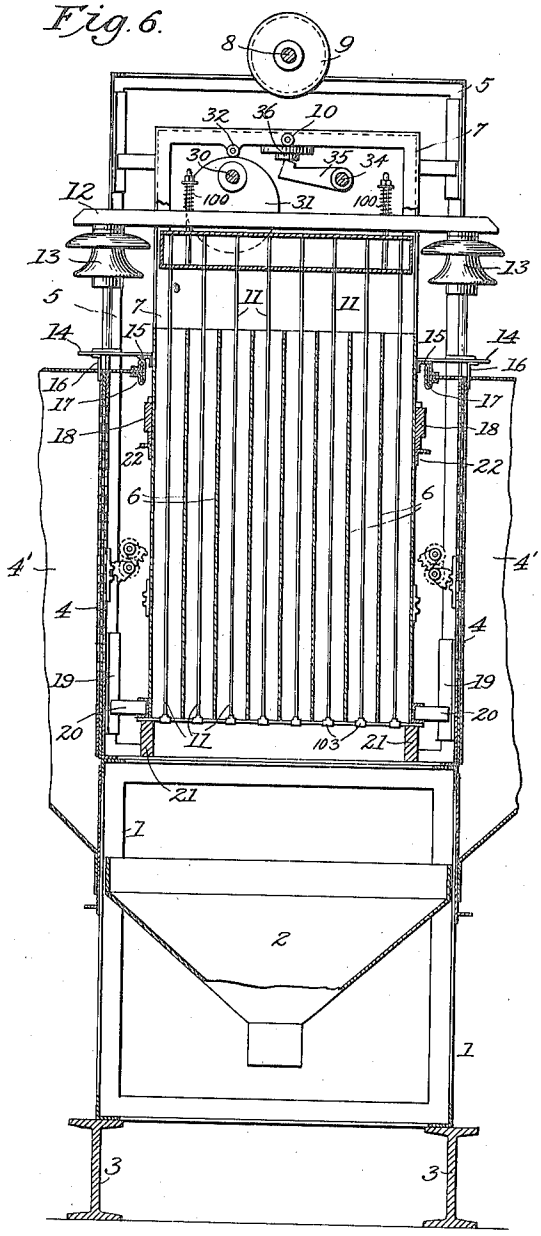
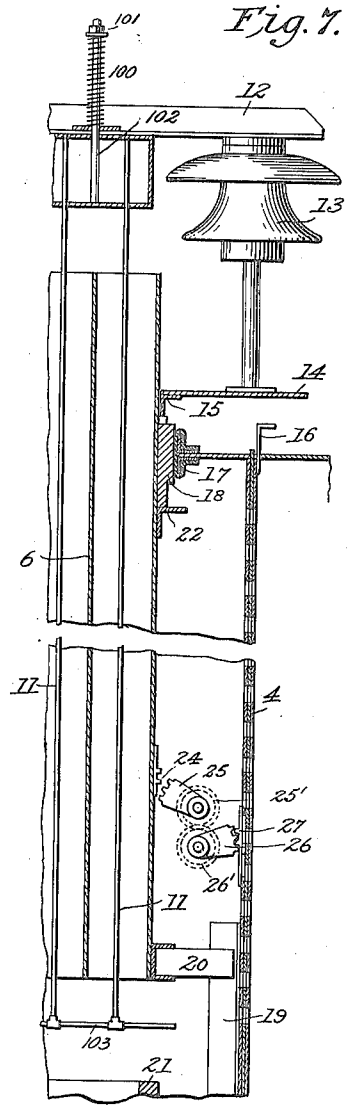


Fig. 7.



Witnesses

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5 SHEETS—SHEET 5.

Fig. 8.

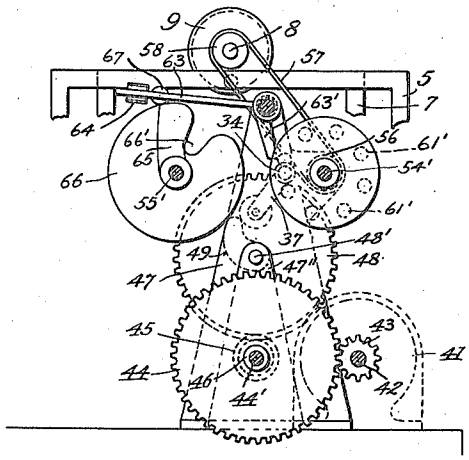


Fig. 9.

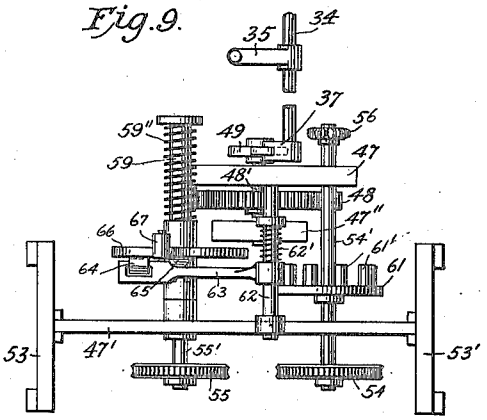


Fig. 10.

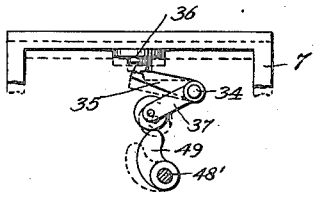


Fig. 11.

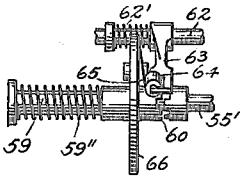


Fig. 12.

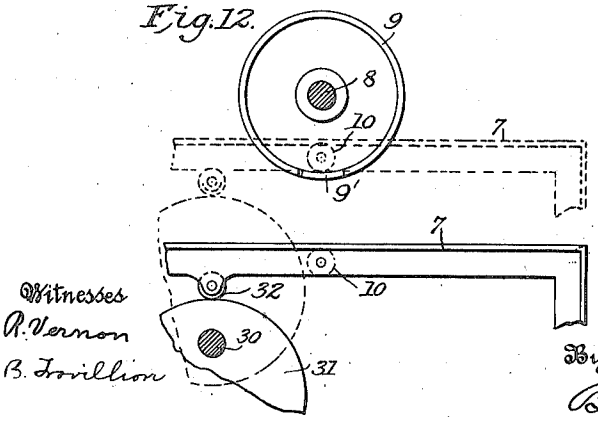
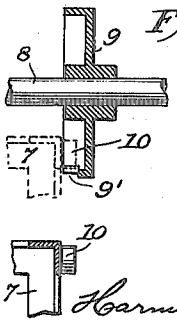


Fig. 13.



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Patented Oct. 24, 1922. 1,433,266

UNITED STATES PATENT OFFICE.

HARMON FRANCIS FISHER, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO RESEARCH CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SELF-CLEANING ELECTRIC PRECIPITATOR.

Application filed November 26, 1919. Serial No. 340,835.

To all whom it may concern:

Be it known that I, HARMON FRANCIS FISHER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Self-Cleaning Electric Precipitators, of which the following is a specification.

The present invention relates to apparatus for the electrical treatment of gases carrying particles in suspension and more particularly to means for automatically cleaning the electrodes.

The principal object of the invention is to provide a precipitator structure which operates automatically to remove the deposit from the electrodes.

It is the more particular object to provide a precipitator preferably of the multi-unit type and means for automatically and periodically cleaning the different units.

The invention in its simplest aspect comprises a movable electrode structure and means for moving the structure in such a way as to effectively dislodge matter normally adhering thereto.

The objects of the invention, the principle of operation and the result will appear more clearly from the specification in connection with the accompanying drawings in which:

Fig. 1 represents a device embodying the invention, certain parts being broken away to show the interior.

Fig. 2 is an end view thereof;

Fig. 3 is a plan view of the device shown in Fig. 1, certain parts being shown in section;

Figs. 4, 5 and 6 are sectional views of a treater unit illustrating different positions of the operating mechanism during a cycle of operation;

Fig. 7 is a fragmentary sectional view on an enlarged scale indicating certain structural detail in the position shown in Fig. 4;

Fig. 8 is a sectional view along line 8—8 in Fig. 9;

Fig. 9 is a plan view of certain mechanical detail forming part of the mechanism shown at the right hand end of Fig. 3;

Fig. 10 is a fragmentary view in elevation of a mechanical detail arrangement;

Fig. 11 is a fragmentary plan view of a detail; and

Figs. 12 and 13 are fragmentary views in elevation and section respectively, showing the relation of certain operating detail in two operating positions.

As shown in Figs. 1 and 3 the invention is preferably applied to a precipitator composed of a plurality of treater units marked A, B, C, D, E and F. Each treater unit comprises principally three distinct parts, namely, a general frame including a lower chamber or header which serves both as a receiving chamber for the gases to be cleaned and as a support for the rest of the structure, a movable group of nested pipes constituting collecting electrodes and extending into the chamber and discharge electrodes. The collecting electrodes, the discharge electrodes or both are constructed for movement relatively to the chamber as will be pointed out hereinafter more in detail.

The structure of a single treater unit may be understood by reference to Figs. 4, 5 6 and 7 in which the chamber 1 with a closed hopper bottom 2 is shown as permanently mounted on the two I-beams 3. Above the hopper are dampers 4 which are designed to control the admission of gas to the treater from supply pipes 4.

From the chamber structure 1 extends upwardly a frame 5, preferably of angle iron, which carries, as will be more particularly described, the collecting electrodes and certain operating mechanism. The collecting electrodes which may be pipes or tubes 6 are contained in an iron bound angle iron frame work 7 which is solidly welded at all its joints so as to form a rigid unit and is slidable in up and down direction relatively to the chamber 1 and frame 5. On the top of frame 5 is mounted a shaft 8 carrying a cup wheel 9 and the frame 7 has a roller 10 projecting laterally from the upper end thereof to engage the cup wheel whereby the frame 7 is suspended from frame 5.

The shaft 8 extends along the top of the frames 5 of all the treater units and car-

ries as many cup wheels as there are treater units. If desired, the frames 5 and chambers 1 of the treater units may of course be combined in a single integral structure.

The discharge electrodes 11 are suspended in the usual way from the cross-arms 12 mounted upon insulators 13 and the insulators 13 are mounted upon a frame 14 which fits loosely about the collecting electrode structure and normally rests upon lugs 15 preferably welded on the frame work 7. When the frame work 7 and the collecting electrodes are moved downwardly, the discharge electrode support moves with it until it comes in contact with a set of fixed lugs or bars 16 on the frame 5. Then the discharge electrode frame is held while the pipe structure continues its downward motion.

A seal is composed of a stationary asbestos-graphite packing ring 17 fixed to and supported by the frame work 5 immediately above the dampers 4 and a metal sealing ring 18 attached to the frame 7 and movable therewith. In normal position, as indicated in Fig. 7, the metal sealing ring 18 engages the packing ring 17 and closes the top of the chamber or lower header so that the gas cannot escape upwardly around the pipe structure.

To the walls of the chamber 1 are attached wearing plates 19 and to the frame 7 guide elements 20 in sliding relation therewith to direct the motion of the collecting electrode structure.

Below the collecting electrode structure and carried by the walls of the chamber 1 is a frame consisting of heavy beams 21. The position of this frame is such that it intercepts the downward motion of the collecting electrode structure and jars it.

The pipe supporting frame 7 carries an angle iron shelf 22 upon which is mounted the sealing ring 18. The particular means for closing the damper at the beginning of the downward motion and opening it at the close of the upward motion are not material. For purposes of illustration I have shown in Fig. 7 teeth 24 formed on the frame 7 and teeth 27 on the damper frame. A segmental gear 25 is mounted to intercept the movement of the teeth 24 and a segmental gear 26 engages the teeth 27 on the damper frame. The two segmental gears are interconnected through gears 25′ and 26′. When the pipe structure begins to descend, the motion is immediately transmitted to the damper to cause it to close. When the teeth 24 have passed out of engagement with the segmental gear 25 the damper is closed and the pipe structure continues its descending movements. When the pipe structure rises again, the teeth 24 come into contact with the gear 25 at the end of the movement and open the damper just at the time when the parts are about to reach normal or operative position.

Below the top of the frames 5 and carried thereby is a shaft 30. On this shaft 30 are mounted a plurality of cams 31, one for each treater unit and from the frame 7 of each treater unit projects a roller 32 in the plane of motion of the cam 31. Each of the cup wheels 9 has a slot 9′ (see Fig. 12) through which the roller 10 may pass when the slot 9′ is in its lowermost position so that the frame 7 of each treater may be released from the cup wheel. When this happens the roller 32 comes into contact with the cam 31 and as the cam rotates, the frame 7 is lowered, the roller 32 riding on the working surface of the cam 31 until the cam reaches its lowermost position. As rotation continues, the frame 7 is again gradually lifted to its original position.

On the frames 5 is mounted a shaft 34 carrying a plurality of arms or levers 35. By suitable mechanism, as will be more particularly described, this shaft is rocked so as to impart oscillating motion to the arms 35. When a frame 7 is approaching its lower position as determined by the cam 31 the arm 35 comes in contact with a contact plate 36 and will alternately raise and lower frame 7 so long as the plate 36 is within reach. The frame 7 and collecting electrode structure is thus alternately dropped onto and raised from the beams 21 and thereby knocked or jarred.

The mechanism for operating the shafts 30 and 34 is shown in detail in Figs. 8–11.

On a platform 40 adjacent one end of the series of treaters is mounted a motor 41 and the necessary transmission for successively and periodically operating the various units as described, a second motor 41′ being mounted on the platform for rotating the usual mechanical rectifier (not shown).

The motion of the motor shaft 42 is transmitted through pinion 43 and gear 44 to a gear 45 and a worm 46 both keyed upon the shaft 44′ mounted in frame elements 47 and 47″. The gear 45 meshes with gear 48 keyed to the short shaft 48′ having bearing in the frame elements 47 and 47″. On the end of the shaft 48′ is mounted the cam 49 which is so positioned as to engage and oscillate during each revolution the arm 37 on shaft 34.

The worm 46 meshes with the worm gear 50 and thereby drives the worms 51 and 52 carried by the shaft 50′ which is mounted on frame elements 53 and 53′. Worm 52 in turn meshes with gear 54 while worm 51 engages gear 55 mounted on shafts 54′ and 55′ respectively. On the end of shaft 54′ is mounted a chain wheel 56 which through chain 57 drives a second chain wheel 58 fixed to shaft 8 carrying the cup wheels 9.

The shaft 8 is thus continuously rotated. In order to successively disengage the several frames 7 from the corresponding cup wheels, the slots 9′ occupy different angular positions. If six treater units are employed the slots 9′ occupy positions progressively varying by 60 degrees so that in the course of one revolution of shaft 8 all treaters are once lowered for cleaning.

Shaft 55′ is connected with the shaft 30 to rotate the cams 31 as previously described. For reasons to be more fully explained it is desired to rotate the cams 31 intermittently so as to provide a period of rest. To this end the connection between shaft 55′ and shaft 30 is effected through a separate shaft 59, a clutch mechanism 60 and means for automatically engaging and disengaging the clutch mechanism.

Having particular reference to Figs. 8, 9 and 11, on the shaft 54′ is mounted a cam wheel 61 containing 6 cam pins 61′. On a suitably mounted shaft 62 is pivoted at one end an arm or lever 63 having a crank 63′ intercepting the path of the cam pins 61′. The other end of arm 63 carries a roller 64 so positioned as to bear laterally against the beveled surface 65 of a cam 66 which is slidably keyed upon the shaft 59. The shaft 55′ and the cam 66 carry at their abutting ends clutch elements forming the clutch mechanism 60. A spring 62′ interposed between the shaft 62 and the arm 63 forces the arm 63 down against the beveled surface 65 with sufficient force to push the cam 66 away from the shaft 55′ thereby separating the clutch elements and disconnecting shaft 59 from the drive shaft 55′. The shaft 59 is in alignment with the shaft 30 and coupled thereto. The end of the shaft 59 is provided with a flange 59′ to act as an abutment for the spring 59″ which tends to force the cam 66 toward shaft 55′ and to connect the elements of the clutch mechanism 60. The cam 66 consists of a disk having a cam slot 66′ of small angular extent. The arm 63 carries also a lateral projection on which is mounted a roller 67 so disposed as to ride over the edge of the disk and into the cam slot 66′. The pitch of the forms 51 and 52 and the diameter of the gears 54 and 55 are so chosen that while the cam wheel 61 is rotated through an angle corresponding to the distance between adjacent cam pins 61, the shaft 55′ tends to make more than one revolution so that the cam 66 is caused to make a complete revolution and remains at rest a definite interval during which the clutch is disengaged. This period of rest may be varied between certain limits by changing the ratio of the gear 55 and worm 52 and by changing the relation between the cam pins 61′ and the crank 63. When the crank 63′ is free of a cam pin 61′, the spring 62′ will force the arm downwardly so that the roller 64 will act on the beveled surface 65 of cam 66 as soon as the cam slot 66′ is opposite the roller 67 and disengage the clutch. The shaft 59 will then stay at rest until the crank 63 is actuated again by the next cam pin 61′. When the next cam pin 61′ has raised the arm 63 a certain amount, the clutch elements will again connect and the cam will make again a complete revolution. Thus the cam 66 will periodically make a complete revolution and then stop a definite period.

The operation of the device is as follows:

The slot 9′ in the cup wheels 9 are so related that during one revolution of shaft 8 the various frames 7 are successively lowered for the cleaning operation. As the slot 9′ of each cup wheel approaches its lower-most position, the roller 10 will pass through the slot and the frame 7 will be released. The cam wheel 61 which is driven from the same shaft as shaft 8, namely shaft 54′, and the mechanism for operating the clutch 60 are so related that each cam 31 is at rest in its highest position when a frame 7 is released. The roller 32 will thus come to rest on the cam 31 and when the latter begins to revolve, the roller 32 will roll down the working face of the cam to its lower-most position and after the cam 31 has passed its lower-most position it will take the roller 32 up to its original position again. The slot 9′ of the particular cup wheel 9 is so dimensioned that the roller 10 can still pass through it to reach its original position within the cup wheel.

The shaft 8 will continue to rotate to bring another slot 9′ into releasing position and the movement of the mechanism for operating the cams 31 is so timed that the corresponding cam 31 is also at rest when the release takes place. The operation is the same for all treater units.

When a frame 7 descends to the knocking operation, the teeth 24 actuate the dampers to close immediately as described. The discharging electrode frame descends with the frame 7 until it comes in contact with the abutments 16 as described. It then remains in fixed position while the frame 7 continues its downward motion. As soon as the plate 36 comes within reach of the arm 35, the frame 7 will be alternately lifted and dropped upon the anvil and thereby jarred. This jarring or knocking operation continues until the plate 36 passes again out of reach of arm 35. The angular movement of the arm 35 has been exaggerated considerably. In practice the movement of the arm 35 is such

that the frame is lifted about an inch or any other relatively small distance sufficient to accomplish the purpose of knocking off the deposit from the pipes.

The discharge electrodes may be jarred simultaneously by the simple arrangement disclosed in Figs. 6 and 7. The discharge electrodes are resiliently suspended from cross arms 12 by means of springs 100 interposed between the head 101 of an extension 102 to the lower end of which the discharge electrodes are attached and the cross-arms. The usual spaces from 103 through which the electrodes pass is extended to intercept the downward movement of the pipe structure. When the discharge electrode system comes to rest upon the abutments 16, the spacer frame 103 is in the position indicated in Fig. 5, just a trifle above the anvil 21. As the pipe system approaches the anvil, it takes the spacer frame along and thereby subjects the discharge electrodes to a violent vibration, the discharge electrodes being pulled down against the tension of springs 100 and spring back when the pipe system is lifted again. The strength of the springs 100 and the position of the abutments 16 may be suitably chosen so that the knocking action effects the cleaning of the discharge electrodes without in any way injuring them.

It remains to be said that the discharge electrode system is disconnected from the busbar at the very beginning of the downward motion. As shown in Figs. 1, 2 and 3, the cross-arms 12 carrying the discharge electrodes 11 are electrically connected with the busbar 11′ (carried upon insulators 11″) by means of blade switches 12′ which contact upwardly with the busbar. This contact is at once broken with the downward movement.

During the lowering operation the members 17 and 18 of the seal separate so as to minimize wear on the sliding surface.

When the frame 7 together with the discharge electrode system reaches again its highest position, the motion of the cam 31 ceases. The roller 10 enters the slot 9′ of the cup wheel 9 and is subsequently held by the rim of the cup wheel while shaft 8 is being revolved to operate another treater unit.

It is understood that many changes can be made within the scope of the idea of operation on which the apparatus is based. By the arrangement described or modified in various ways the electrodes may be cleaned, either the collecting electrodes alone or the discharge electrodes alone or both together as described. The transmission mechanism disclosed is of course merely one concrete example of the many devices that can be constructed to carry out the broader object.

While the preferred form in which the invention is carried out is a multi-unit treater, which has undoubtedly various advantages over the single unit treater, the invention may be embodied in a single-unit treater. It is obvious that the mechanism may be so designed that the time element during which the cleaning takes place is reduced to a very short period. The period of interruption of the normal precipitating function may be shortened so that it is a negligible factor. For this reason I do not intend to limit myself to a multi-unit treater.

It is also evident that the discharge electrodes may be pulled against the tension of the springs and vibrated by means which are independent of the collecting electrodes.

I claim:

1. In an electrical precipitator the combination of a discharge electrode, a collecting electrode movable in the direction of its length, an abutment in the path of movement and means for moving the collecting electrode against and away from the abutment.

2. In an electric precipitator, a discharge electrode and means operative upon the electrode in the direction of its length for subjecting the electrode to sudden impulses causing tension intermediate its ends.

3. In an electric precipitator, a discharge electrode and means periodically operative upon the electrode in the direction of its length for subjecting the electrode to sudden impulses causing tension intermediate its ends.

4. In an electric precipitator, a discharge electrode a collecting electrode movable in the direction of its length, means for moving the latter, and means on the collecting electrode and on the discharge electrode for causing a tensioning of the latter during the movement of the former.

5. In an electric precipitator, a discharge electrode, a collecting electrode movable in the direction of its length, means for moving the latter; an abutment in the path of movement and means for periodically moving the collecting electrode against and away from the abutment.

6. In an electrical precipitator the combination of a collecting electrode, a discharge electrode, means for movably supporting the collecting electrode, an obstruction in the path of movement thereof, means for periodically moving the collecting electrode against and away from the obstruction and means operative to rap the discharge electrode during the said movement.

7. In an electrical precipitator, the combination of a collecting electrode, a discharge electrode, means for resiliently supporting

the discharge electrode at one end and means for acting upon the other end of the discharge electrode to impart to it a sudden impulse against the action of the said resilient supporting means.

8. In an electrical precipitator, the combination of a collecting electrode, a discharge electrode, means for resiliently supporting the discharge electrode at one end and means for periodically acting upon the other end of the discharge electrode to impart to it sudden impulses against the action of the said resilient supporting means.

9. In an electrical precipitator, the combination of a vertical collecting electrode, movable in the direction of its length, a discharge electrode, an obstruction in the path of motion below the collecting electrode and means for moving the collecting electrode against and away from the obstruction.

10. In an electrical precipitator, the combination of a vertical collecting electrode, a discharge electrode, means for supporting the collecting electrode for up and down motion, an obstruction in the path of motion below the collecting electrode, means for lowering the collecting electrode in proximity to the said obstruction and means operative to repeatedly jar the collecting electrode against the obstruction while it is in such position.

11. In an electrical precipitator the combination of a collecting electrode, a discharge electrode, means for supporting the discharge electrode upon the collecting electrode, means for supporting the collecting electrode for up and down motion, an obstruction in the path of movement of the collecting electrode and means for moving the said collecting electrode against and away from the said obstruction to jar both electrodes.

12. In an electrical precipitator the combination of a vertical collecting electrode, a discharge electrode, means for supporting the collecting electrode for movement in the direction of its length, an obstruction in the path of movement, means for moving the collecting electrode against and away from the obstruction and means for disconnecting the discharge electrode from the source of supply during such movement.

13. In an electrical precipitator the combination of a collecting electrode, a discharge electrode, means for supporting the said electrodes for movement in the direction of its length, an obstruction in the path of movement, means for moving the electrodes against and away from the obstruction and means for disconnecting the discharge electrode from the source of supply during such movement.

14. In an electrical precipitator the combination of a plurality of treater units, each comprising a collecting electrode and a discharge electrode, means for movably supporting the said units, an obstruction in the path of movement, means for separately moving the various treater units against and away from the obstruction and means for disconnecting each treater unit from the source of supply during its movement.

15. In an electrical precipitator the combination of a plurality of treater units, each comprising a collecting electrode and a discharge electrode, a separate gas receiving chamber for each treater unit and separate means for controlling the admission of gas to each chamber, means for movably supporting the collecting electrode of each unit, an obstruction in the path of movement, means for separately moving the collecting electrode of each unit against and away from the obstruction and means for automatically operating said gas controlling means during such movement.

16. In an electrical precipitator the combination of a plurality of treater units, each comprising a collecting electrode and a discharge electrode, a separate gas receiving chamber for each treater unit and separate means for controlling the admission of gas to each chamber, means for movably supporting the collecting electrode of each unit, an obstruction in the path of movement, means for successively moving the collecting electrode of the various units against and away from the obstruction and means for automatically operating the said gas controlling means during such movement.

17. In an electrical precipitator the combination of a plurality of treater units, each comprising a collecting electrode and a discharge electrode, means for movably supporting the said units, an obstruction in the path of movement, means for successively moving the various units against and away from the obstruction and means for disrupting the electrical connection to each unit during the movement.

18. In an electrical precipitator the combination of a plurality of treater units, each comprising a tubular collecting electrode and a discharge electrode and means for movably supporting the collecting electrode, an obstruction in the path of movement of each collecting electrode and means for periodically and successively moving the collecting electrode against and away from the said obstruction.

19. In an electrical precipitator the combination of a plurality of treater units, each comprising a tubular collecting electrode and a discharge electrode and means for movably supporting the collecting electrode, an obstruction in the path of movement of

each collecting electrode, means for periodically and successively moving the collecting electrode against and away from the said obstruction and means operative to repeatedly lift and drop the collecting electrode to jar it against the obstruction during such movement.

20. In an electrical precipitator the combination of a plurality of treater units, each comprising a tubular collecting electrode and a discharge electrode, and means for movably supporting the said electrodes, an obstruction in the path of movement, means for periodically and successively moving the electrodes against and away from the obstruction and means operative to repeatedly jar the electrodes against the obstruction during such movement.

21. In an electrical precipitator, insulator means, springs supported on the insulator means, a frame carried by said springs and discharge electrodes mounted in said frame.

In testimony whereof, I affix my signature.

HARMON FRANCIS FISHER.