June 24, 1930. W. SYKES 1,767,265

APPARATUS FOR ELECTRICAL PRECIPITATION

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Fig. 1.

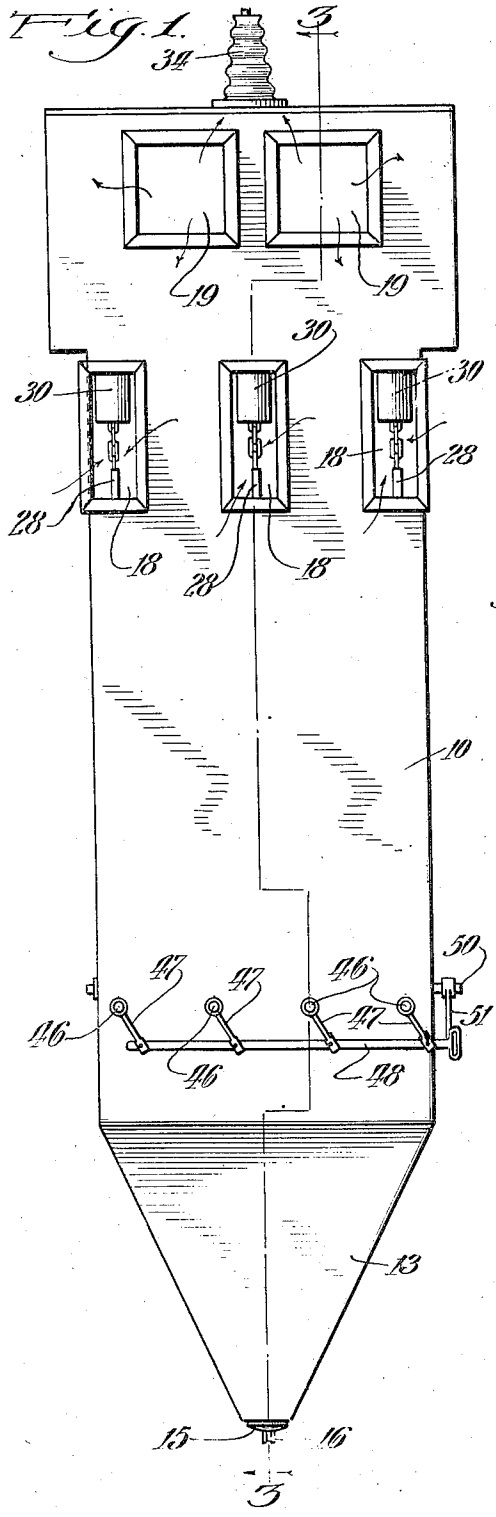

Fig. 2.

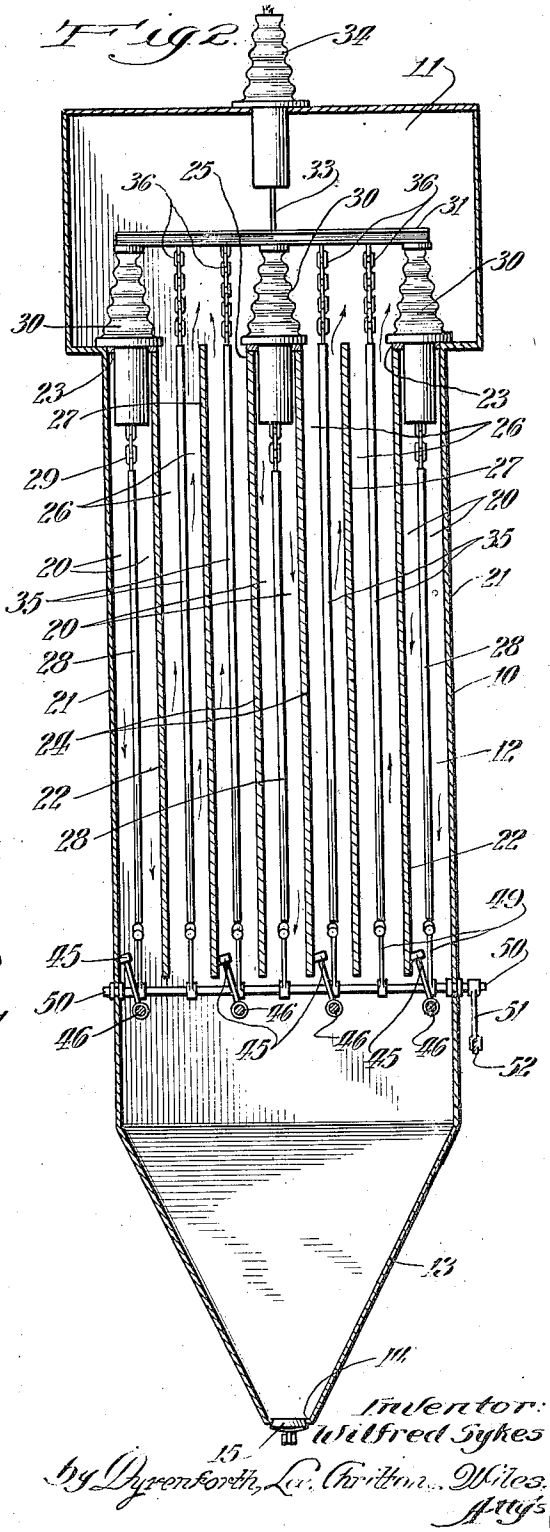

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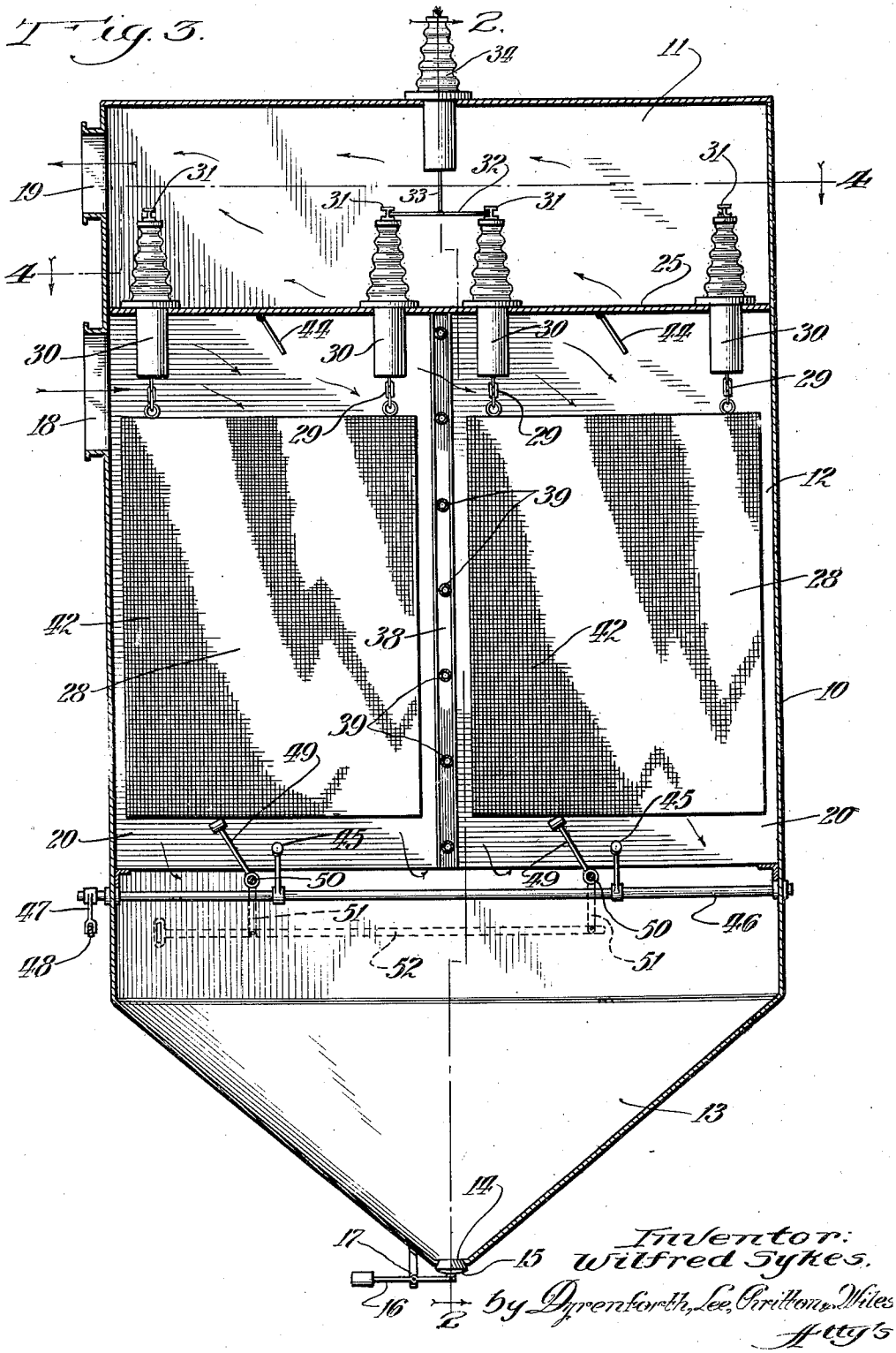
Fig. 3.



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APPARATUS FOR ELECTRICAL PRECIPITATION

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Fig. 4.

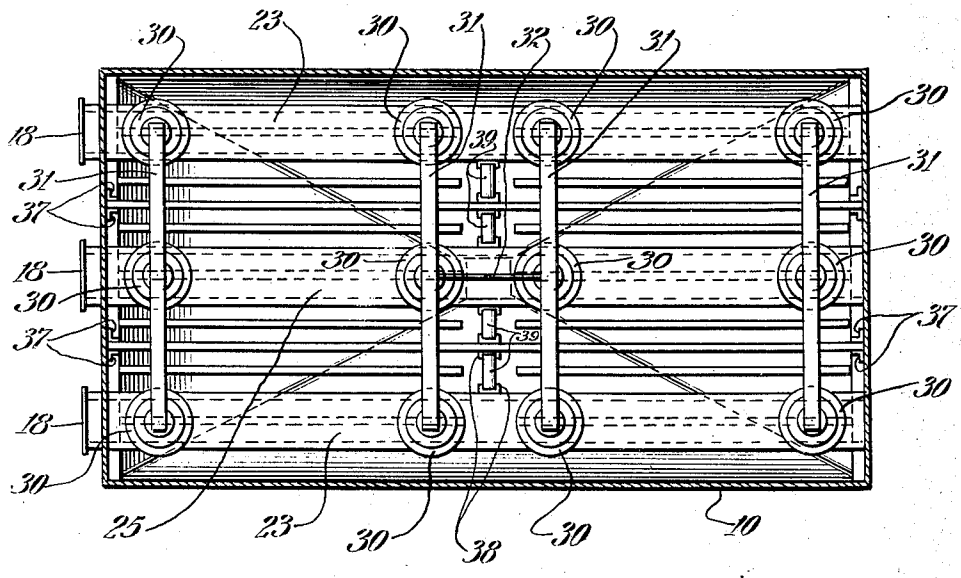


Fig. 5.

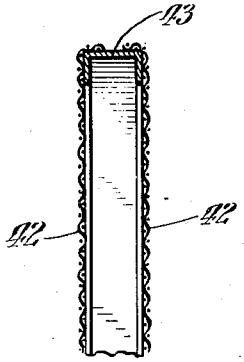
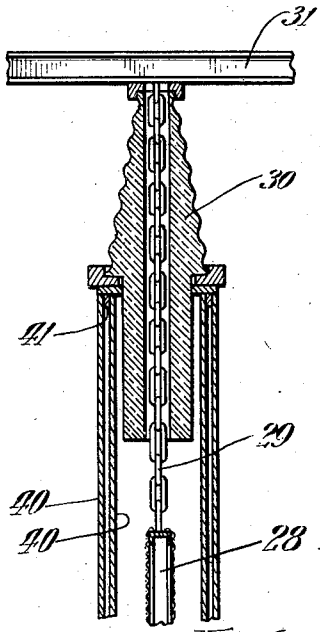


Fig. 6.



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UNITED STATES PATENT OFFICE

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APPARATUS FOR ELECTRICAL PRECIPITATION

Application filed November 29, 1926. Serial No. 151,496.

My invention relates to apparatus for effecting the separation of solid particles from gaseous fluids, such for example as the separation of flue dust from the gaseous fluid discharged into the stack from blast furnaces, by the subjection of the gaseous fluid to an electrostatic field, or, in other words, to apparatus of the so-called electrical precipitation type.

In connection with one of the objects of my invention, it may be stated that the heavier the particles, the more readily they may be precipitated by the action of the electrostatic field, and the higher the velocity of the gaseous fluid, the greater the tendency of the sweeping of the particles from the collecting or precipitating, electrodes into the stream of gaseous fluid, and thus a velocity which would not be excessive as to the heavier particles, would be excessive as to the lighter particles.

In apparatus, as hitherto provided, so far as I am aware, no provision is made for compensating for this condition, which should be compensated for where economy of structure and conservation of space is desired.

It is therefore one of my objects to provide an apparatus by which the gaseous fluid during the flow thereof throughout the first portion of the course in which the fluid is subjected to the electrostatic field, travels at a relatively high velocity during which travel the heavier of the solid particles are removed from the gaseous fluid; and throughout the remainder of the course travels at a relatively low velocity to permit of the effectual precipitation of the lighter solid particles from the gaseous fluid.

Another object is to provide for the effecting of the precipitation of the solid particles by apparatus which shall be of simple and economical construction and occupy the minimum space.

Other objects are to provide an electrode of such form as to cause the electrical discharge therefrom to occur over a large number of points at the face of the electrode and whereby equalization of the pressure of the stream of gaseous fluid at opposite sides of the electrode may be maintained substantially equalized; and other objects as will be manifest from the following description:

Referring to the accompanying drawings:—

Figure 1 is an end view of apparatus embodying my invention. Figure 2 is a view in sectional elevation of the apparatus, the section being taken at the irregular line 2—2 on Fig. 3 and viewed in the direction of the arrows. Figure 3 is a view in vertical sectional elevation of the apparatus viewing the latter from the right in Fig. 2, the section being taken at the irregular line 3—3 on Fig. 1 and viewed in the direction of the arrows. Figure 4 is a plan sectional view taken at the irregular line 4—4 on Fig. 3 and viewed in the direction of the arrow. Figure 5 is an enlarged fragmentary cross sectional view of one of the similar negative, "discharge" electrodes of the apparatus; and Figure 6, a similar view of another detail of the apparatus.

The apparatus shown and which, in practice, would be interposed in the course through which the gaseous fluid containing solid particles to be removed therefrom, flows, comprises a casing 10 constructed of sheet metal to provide an upper chamber 11, and a lower chamber 12 the bottom of which latter is of hopper form, as represented at 13, and contains an outlet 14 at its lower end shown as controlled by a valve 15 mounted on a weighted lever 16 fulcrumed at 17 on the casing 10.

The casing 10 is shown as containing a plurality of inlets 18 for the gaseous fluid to be operated on, these inlets being located adjacent the upper end of the chamber 12; the outlets for the cleaned gaseous fluid being represented at 19 and located in an end wall of the casing, adjacent the upper portion of the chamber 11.

The inlets 18 communicate with vertical flues 20 of a number corresponding with the inlets 18, though both the number of inlets and the number of these flues may be varied as desired. The two outermost flues are formed by opposed side walls 21 of the casing which are arranged in parallel relation, and metal plates 22 arranged parallel with the walls 21. The plates 22 extend the full length of the casing and from a point adjacent the upper

portion of the chamber 12 to a point short of the bottom of the latter, as shown, the upper ends of the two outside flues now being described, being closed by plates 23. The intermediate one of the flues 20 is formed of a pair of metal parallel plates 24 extending the full length of the casing and reaching from a point adjacent the upper extremity of the chamber 12 to a point short of the bottom thereof, the upper end of this flue being closed by a plate 25.

The flues 20 thus extend downwardly through the casing and open into the bottom thereof, the opposed side walls of these flues, in the operation of the apparatus, being positively electrically charged and forming plate precipitators for the solid particles in the gaseous fluid passed therethrough.

The apparatus also comprises upwardly discharging flues into the lower ends of which gaseous fluid discharged from the lower ends of the flues 20, passes, and thence upwardly into the chamber 11, these flues being represented at 26 and in accordance with one feature of my invention present a combined cross sectional area greater than the combined cross sectional area of the flues 20. In the arrangement shown each flue 26 is of the same cross sectional area as that of each flue 20, and two flues 26 are located between the adjacent flues 20, thus providing four of the flues 26. The flues 26 are formed of the plates 22 and 24 and intermediate plates 27. The plates 27 are arranged parallel with the plates 22 and 24 and all of the plate members 21, 22, 24 and 27, which parallel each other, are equidistantly spaced apart, the plates 27 also, in practice, being positively electrically charged and forming precipitator electrodes.

Each of the downwardly and upwardly discharging flues referred to contains a pair of discharge electrodes which, in the operation of the apparatus, are negatively charged. The discharge electrodes in the flues 20 are represented at 28, these electrodes being of general plate-like form preferably of the construction hereinafter described and suspended in these flues midway between the opposite side walls thereof and in spaced relation thereto, as by means of chains 29 connected with the upper edges of the electrodes 28 adjacent the ends thereof, and extending upwardly through openings in the plates closing the upper ends of these flues and through insulators 30 extending through these plates and supported thereon as shown, the upper ends of the chains 29 being connected with supporting cross members 31 seated on the insulators 30, intermediate ones of the cross members 31 being electrically connected together by a metal bar 32 which is connected with a conductor 33 extending upwardly through an insulator 34 mounted in the top of the casing 10, and, in practice, connected with the negative side of a high potential electrical circuit, the positive side of which would be grounded and thus in circuit with the precipitator electrodes described.

The flues 26 contain negative, discharge, electrodes 35 preferably of the construction hereinafter described and supported to extend parallel with, and equidistantly from, the opposite walls of the flues in which they are located, as by means of chains 36 connected with the cross members 31 and thus negatively charged in the operation of the apparatus, it being preferred that the lower edges of all of the negative electrodes extend substantially in the same plane and above the lower edges of the positive electrodes.

It may be here stated that the various intermediate precipitator electrodes are secured in place in the casing by any means suitable for maintaining them in the desired parallel relation. In the particular construction shown these intermediate electrodes are mounted at their lateral edges between angle irons 37 secured to the end walls of the casing, and between their ends engage at channel bars 38 thereon with spacer members 39.

It is preferred that the precipitator electrodes located between the electrodes 21, be each formed of two parallel plate members 40 (Fig. 6) connected together by a marginal frame represented at 41 and located between these plates and secured thereto in any desirable way.

The negative, or discharge, electrodes, may be formed of sheet metal, but preferably are formed as illustrated, namely, to provide those portions thereof which parallel adjacent positive electrodes, of interstitial form, for the dual purpose of providing for the electrical discharge from the negative to the positive electrodes from a large number of points on the negative electrodes and the equalization of the gas pressure at opposite sides of the negative electrodes. Such form of negative electrode may be provided by forming it of sheets 42 of expanded metal which are secured in parallel, spaced apart relation, by means of a marginal frame 43, shown as formed of channel irons, the frame being located between the sheets 42 with the marginal edges of these sheets bent to lap the frame 43 as illustrated in Fig. 5 and in such position secured in any desired manner, as for example by welding them thereto.

The operation of the apparatus is as follows: The gaseous fluid from which the solid particles therein are to be separated, enters the casing 10 through the inlets 18 thence passing downwardly through the flues 20, substantially equal distribution of the gas throughout these flues being effected by the provision of deflectors 44, the fluid discharging from the lower ends of these flues into the bottom of the chamber 12 and thence rising through the flues 26 into the chamber 11 from

which latter it discharges through the outlets 19.

The electrodes 28 and 35 being negatively charged with the high potential current, the solid particles in the gaseous fluid travelling through the flues as stated are subjected to a strong electrostatic field whereby the solid particles become negatively charged and thus become attracted to the positive electrodes forming the walls of the flues, and become precipitated thereon.

In the passage of the gaseous fluid through the down flues referred to, the heavier particles therein are either deposited on the sides of the precipitator electrodes or drop out of the gas stream when the direction of flow of the latter changes by virtue of the provision of the upwardly extending outlet flues and the velocity of the gas stream becomes reduced because of the provision of the up flues as of larger effective cross sectional area than the down flues. The gaseous fluid flows from the chamber 12 upwardly through the up flues, at a reduced velocity, with the result of effecting the precipitation of the lighter particles upon the precipitator electrodes and thus the gaseous fluid discharges from the apparatus substantially free of solid particles, it being noted that by reason of the reduction of the velocity of the gas in the up flues the particles are subjected to the electrostatic field for a greater length of time and likelihood of the sweeping of the particles from the precipitator electrodes, is practically eliminated.

It is desirable that means be provided in apparatus of this character, for subjecting the positive electrodes to a rapping action to dislodge the particles precipitated thereon, this being effected, in the particular construction shown, by providing, for cooperation with the positive electrodes, hammers 45 mounted on rock shafts 46 to extend between adjacent ones of the positive electrodes and alternately rap them in the oscillations of the shafts 46, these shafts being provided at their outer ends with arms 47 pivotally connected with an operating bar 48. The means shown for rapping the negative electrodes comprise hammers 49 secured on shafts 50 in position to be swung against the lower edges of the electrodes, the shafts 50 being provided with arms 51 pivotally connected with an actuating bar 52.

It will be understood from the foregoing that an apparatus constructed in accordance with my invention not only serves to very effectually clean the gaseous fluid of its contained solid particles, but may be economically constructed and is of very compact form, it being observed that the electrodes in the up flues may be provided of greater length than those in the down flues, with manifest advantage, without enlarging the apparatus.

While I have illustrated and described a particular embodiment of my invention, I do not wish to be understood as intending to limit it thereto as the same may be variously modified and altered without departing from the spirit of my invention.

What I claim as new, and desire to secure by Letters Patent, is:

In electrical precipitation apparatus, the combination of a casing containing a series of partitions forming flues certain of which are closed at their upper ends and through which gaseous fluid introduced into the casing, descends, the others of said flues being open to receive, at their lower ends and direct upwardly therethrough, the fluid after passing through said first-referred-to flues, the walls of said flues forming positive electrodes, and negative electrodes located in said flues, the combined cross sectional area of those of the flues through which the fluid passes upwardly being greater than that of the others of said flues.

WILFRED SYKES.