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S. P. MILLER

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ELECTRICAL PRECIPITATION

Filed Dec. 18, 1928

Fig. 1.

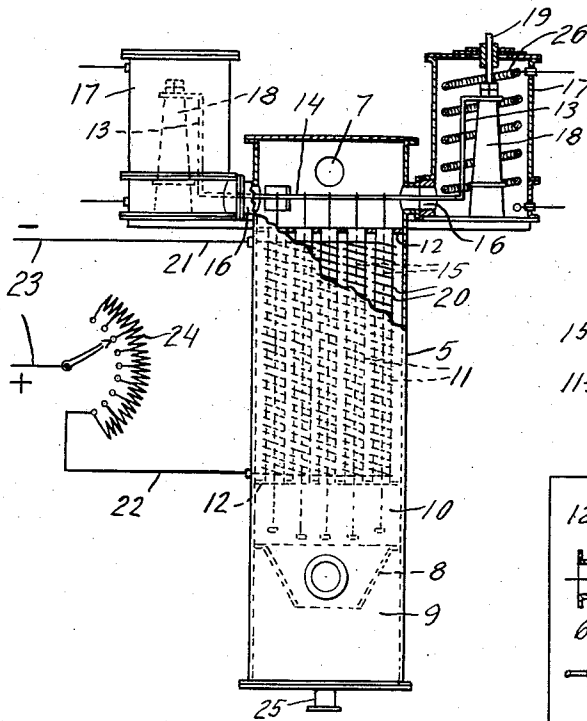


Fig. 4.

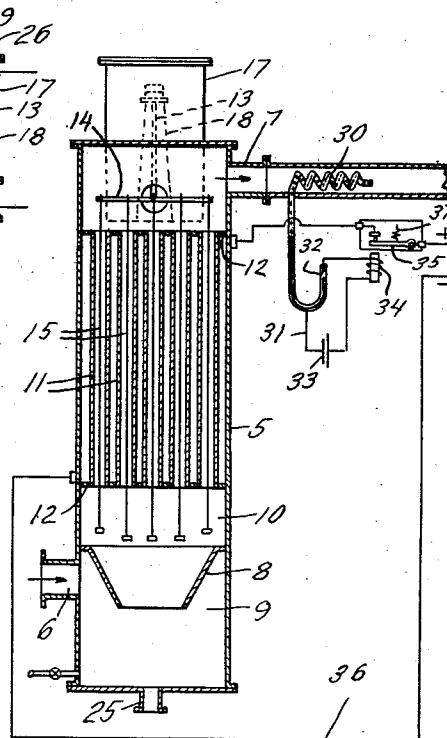


Fig. 2.

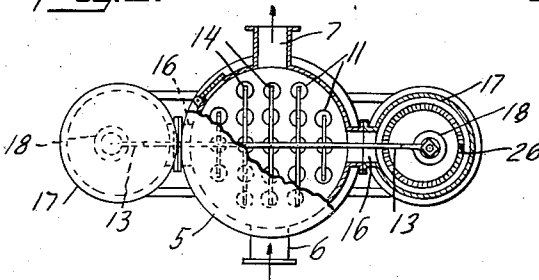
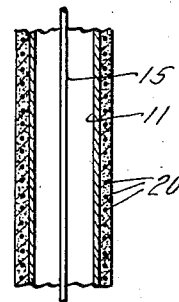


Fig. 3.



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ELECTRICAL PRECIPITATION

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This invention relates to electrical precipitation in which a high tension silent electrical discharge between electrodes is utilized to remove suspended particles from gases passing between the electrodes and to an improved apparatus which facilitates such operations.

Electrical precipitators as heretofore used for removal of entrained solid and liquid particles from gases commonly consist of a casing containing a plurality of vertical tubes connected to headers which serve to deliver gases to and to conduct gases away from the tubes. Each tube has within it a central electrode. The electrodes are connected normally to the negative terminal of a source of high tension uni-directional current while the tubes and casings are connected usually through the ground to the positive terminal of the source of current. The electrodes are insulated from the tubes and casing. In the operation of the precipitator high potential uni-directional current is supplied, for example, from an alternating current generator through a transformer and rotary converter and the gas to be cleaned is directed through the tubes and is thus passed through the field of silent electrical discharge which takes place between the electrodes and tubes and by ionization of the particles to be separated from the gas causes them to collect on the walls of the tubes down which they flow into the bottom of the separator.

The machines commonly used for the cleaning of entrained liquids from gases are commonly constructed with tube 6" in diameter and approximately 9' long. The high potential current employed is commonly supplied to the electrodes at 35,000 to 50,000 volts, although the voltage will depend upon operating conditions, e. g., the type of gas being treated, its velocity through the tubes, the percentage of entrained matter present, etc. Ordinarily the machine is operated with the current at maximum potential, i. e., at the voltage just below that at which arcing from central electrodes to tubes occurs.

In numerous operations involving electrical precipitation it is desirable to maintain the

gases undergoing precipitation at relatively elevated temperatures so as to prevent condensation from the gases of condensable vapors contained therein. Thus, for example, in the cleaning of hot coke oven gases for recovery of liquid pitch directly, and of clean oils from the gases subsequent to the cleaning operation, it is desirable to maintain the gases being cleaned at elevated constant temperatures. The dewpoints of the hot gases for the several condensable oil constituents contained therein as vapors are lower than the normal boiling points of the respective oils, and by properly regulating the temperature of the gases in accordance with the dewpoints of the gases for the several oil constituents contained as vapors, certain constituents may be caused to condense while other constituents are retained in the vapor phase.

It is the object of the present invention to facilitate the maintenance of desired temperatures in the electrical precipitator and to provide a precipitator which permits of operation at various elevated temperatures which may be closely regulated, as by automatic temperature control means, for the purpose of closely controlling the separation of desired products in the precipitator and of desired materials from the cleaned gases.

In carrying out the invention the precipitator may be of the usual or of any desired form and construction. It may be provided, for example, with the usual tubes with central discharge electrodes and with a casing surrounding the tubes. It may be connected in the usual way to a source of high tension uni-directional current. Heat may be supplied to the tubes which conduct the gases thru the precipitation zone in order to provide against temperature drop of the gases while passing thru the tubes or to heat the gases to a predetermined extent. The heating can be accomplished effectively by the use of electric heating elements supplied with current from a suitable source. Thus, for example, if the precipitator comprises a plurality of tubes enclosing central electrodes the tubes may be heated electrically by winding upon or otherwise arranging adjacent thereto suitable electric resistance material and by sup-

plying current to the electrical resistance material for the purpose of maintaining the desired temperature of the gases passing thru the tubes. Electrical heating is particularly desirable because exact regulation thereof is possible by the provision of suitable resistances in the heating circuit and automatic control of the heating can easily be maintained. The resistance value of the heating circuit may be varied at will or by automatic temperature control means to modify the amount of current flowing through the circuit and consequently the quantity of heat supplied to maintain any desired temperature. Where automatic temperature control means is employed it may advantageously be actuated by the gases leaving the precipitator so that the temperature of these exit gases may be maintained constant.

In the operation of the invention as described for the purpose of heating the gases undergoing precipitation the amount of heat supplied should be regulated in accordance with the particular requirements of the operation, that is to say by preventing temperature drop of the gases passing thru the tubes, or by raising their temperature, to maintain a temperature in the precipitation zone which will permit the separation of the desired entrained liquid constituents while other desired constituents are retained in the vapor phase and are withdrawn with the gases from the precipitator. The amount of heating which is necessary will depend upon the particular character of the gases which are being treated, the velocity of the gases thru the tubes, and upon the constituents and the proportions thereof which are present in such gases. The temperature and the amount of heat supplied will vary likewise depending upon the constituents which are to be separated in the precipitator.

The heating of the precipitator is of particular value in case the gases are cleaned at relatively high temperatures. In such cases under ordinary conditions, gases entering the tubes would, due to radiation losses from the equipment, leave the tubes at temperatures several degrees below the entering temperature. By supplying heat to the tubes, it is easy to maintain the gases at constant temperature throughout the equipment to have the operation under exact control at all times and to prevent loss by condensation of oils which it is desired to maintain in the vapor phase.

While particular reference has been made to the precipitation of pitch or tar from gases carrying condensable oils in the vapor phase and tar, the invention is not limited to such operations. It may be utilized for various purposes in which similar principles are applied. The invention is, moreover, not limited to the particular apparatus which is

illustrated in the accompanying drawing, in which

Fig. 1 is an elevation, partially in section, of a precipitator with electrical heating means which may be manually controlled;

Fig. 2 is a plan view;

Fig. 3 is a detail of the heating element shown in Fig. 1; and

Fig. 4 is a cross-section of a precipitator of similar construction to that shown in Fig. 1 but with automatic temperature control means.

The precipitator embodying the invention comprises a shell 5 preferably cylindrical in form having a gas inlet 6 near the lower end thereof and a gas outlet 7 near its upper end. A baffle 8 partially separates the lower or liquid collecting chamber 9 from the electrode chamber 10. A plurality of tubes 11 are supported in heads 12 and form the positive electrodes of the separator, the shell of which is grounded. A conducting support 13 extends through the upper part of the electrode chamber and carries bus-bars 14 which support electrodes 15 and hold them at the centers of tubes 11. The conducting support extends through openings 16 into chambers 17 in which insulators 18 afford a support therefor. Current is delivered to the conducting support through a conductor 19 from a suitable source of high tension unidirectional current.

Each of the tubes 11 of the separator is wound with a resistance heating element 20 and the heating elements are connected by conductors 21 and 22 to a source of current 23, a variable resistance 24 being arranged in the circuit to permit regulation of the temperature resulting from the passage of current thru the heating elements. By controlling the current supplied to the heating elements by means of the variable resistance any desired degree of heating can be effected.

Although the heating elements are here shown wound upon the tubes, this is not essential. They may be disposed among or laid upon the tubes in such a manner as to deliver the desired quantity of heat to the tubes.

Heating means 25 may advantageously be provided in or around each of the chambers 17 to prevent condensation of oils from the gases which collect in these chambers. Since the gases which collect in the chambers 17 are separated from the gas stream, the temperature of these gases is more or less independent of the temperature of the gases passing thru the precipitator tubes and the heating means 26 is therefore advantageously located in a separate circuit from that which heats the gases passing thru the tubes, and the amount of current supplied to the coil or other heating means 25 may advantageously be maintained constant being sufficient

to offset the heat loss due to radiation from the chambers 17.

The electrical precipitator and the gas mains may advantageously be insulated against loss of heat.

In the operation of the apparatus as described the gas to be cleaned is introduced through the inlet 6, passes about the baffle 8 and thence upwardly through the tubes 11. The high tension discharge between the electrodes 15 and the tubes 11 causes the precipitation of substantially all solid and liquid particles from the gas. The liquid particles accumulate on the walls of the tubes 11 and flow downwardly over the baffle 8 into the chamber 9. Any solid particles deposited from the gases are carried along with the liquid so that the removed foreign matter is withdrawn continuously from the active zone of the precipitator. The liquid accumulated in the chamber 9 can be withdrawn continuously or periodically thru an outlet 25 at the bottom of the precipitator.

Automatic temperature control means located in the gas exit from an electrically heated precipitator is represented diagrammatically in Fig. 4 which shows a cross-section of a precipitator of similar cross-section to that shown in Fig. 1, like reference numerals indicating like elements, the two figures differing only in the temperature control means employed. The heating elements surrounding the tubes are omitted from Fig. 4 in order to more clearly bring out the structure of the precipitator, but it is to be understood that heating means identical to that shown in Fig. 1 may be employed, or instead of spiral windings other suitable electrical heating means for supplying the required amount of heat may be employed.

The temperature control means comprises a heat-sensitive control element 30 located in the gas exit 7. On expanding this closes the circuit 31 at 32. This circuit is supplied from the battery 33. Closing this circuit actuates the solenoid 34. The lever 35 is attracted to the solenoid and the heating circuit 36 is broken. When, on the other hand, the temperature of the gas leaving the precipitator falls below the predetermined minimum, the element 30 contracts until the circuit 31 is broken at 32. The spring 37 then closes the heating circuit 36 since there is no current passing thru the solenoid, and heat is supplied to the heating elements which in turn raise the temperature of the gases in the tubes. The temperature of the gases in the precipitator may thus be automatically controlled. Where desirable, control means for supplying variable amounts of current thru the heating means may be employed. Types of thermostatic regulators other than shown may likewise be employed.

It is to be understood that the foregoing description is merely illustrative of the in-

vention and that various changes may be made in the structure employed and in the details of operation thereof without departing from the invention or sacrificing any of its advantages. The invention may be applied to raise the temperature of gases passing thru the tubes, or merely to maintain the temperature of these gases constant by supplying only that quantity of heat which would otherwise be lost thru radiation.

I claim:

1. An electrical precipitator comprising means for conveying a gas containing particles to be precipitated thru a field of silent electrical discharge, electric heating means in heat interchange relation with the gases passing therethru and automatic heat control means in operative connection with the circuit of said heating means and located in the gas outlet from the precipitator.

2. An electrical precipitator comprising a number of collecting electrodes with discharge electrodes passing therethrough and electric heating means surrounding the collecting electrodes.

3. An electrical precipitator comprising a number of collecting electrodes with discharge electrodes passing therethrough and electric heating means embedded in the collecting electrodes.

In testimony whereof I affix my signature.
STUART PARMELEE MILLER.