My invention relates to the electrical treatment of gas for the removal of suspended material therefrom. It relates especially to the electrical precipitation of pitch and similar suspended matter from fuel gases, such as producer gas, coal gas, and the like, and to the flushing of the collecting electrodes of apparatus employed for this purpose.

Electrical precipitation processes and apparatus have been used in the past to remove various types of suspended matter from various gases. For example, cement dust, metallic fumes, smoke, and tar have been removed from smelter and furnace stack gases, air and fuel gases, and there have been other applications of this method of treatment. Various types of apparatus have also been developed adapted to the different conditions encountered.

In all known types of precipitation apparatus there are two electrodes or sets of electrodes, known usually as discharge electrodes and collecting electrodes, and these in most instances are insulated from each other and kept at a high potential difference when the apparatus is in operation.

The discharge electrodes usually have a relatively small surface and may be provided with points or sharply curved sections, and they are connected to a generator, rectifier, transformer, or other suitable source of high voltage. The collecting electrodes generally have more extended surfaces which may be flat, curved, or irregular, and which may be provided with apertures if desired. These collecting electrodes are usually grounded.

Perhaps the best known example of apparatus for this purpose is the Cottrell type of precipitator, in which the individual precipitating units consist of a tubular pipe or collecting electrode and a concentric discharge electrode which may be a wire, rod, chain, or the like.

My present invention is well adapted to use in conjunction with apparatus of this type, but is not limited thereto, and may also be used in electrical precipitators in which the collecting electrodes are flat plates or have any other form, and in which the discharge electrodes have any desired form. For the sake of convenience, however, this invention will be described with special reference to a precipitator of the vertical tube type.

In electrical precipitators, the gas to be cleaned passes through tubes or flues, which usually constitute the collecting electrodes, and is there subjected to a high voltage electrical discharge emanating from the discharge electrode. This causes migration of solid and liquid particles carried by the gas to the flue walls or other collecting electrodes present.

The subsequent behavior of the deposited material depends on its physical characteristics. Most liquids, for example, trickle down the electrodes and collect in sumps or reservoirs provided to receive them at the base of the treater. Dry granular solids, such as dusts, for example, may fall from the electrodes after accumulating there in sufficient quantity, or they may be readily removed by rapping or tilting the electrodes. Flushing with water and aqueous solutions has also been practiced to prevent accumulations of dusts and the like.

Some kinds of precipitate do not fall from the collecting electrodes of their own accord, however, and are only removed with great difficulty. Such precipitates tend to form tenacious deposits which decrease the efficiency of the apparatus and cause arcing, counterionization, localized discharges, and other difficulties. This condition is especially prevalent in the electrical precipitation of pitch or heavy tar from fuel gases and the like.

As a specific illustration of the problem with which the present invention deals, I have found that when pitch is precipitated from producer gas which is used to dilute coke oven gas, for underfiring coke ovens, and for other purposes, it accumulates on the collecting electrodes and is very difficult to remove. External heating of the tubes does not make the pitch sufficiently fluid to flow, water flushing is without effect, and direct steam seems to make the pitch adhere more tenaciously. The deposited pitch cannot be satisfactorily dislodged by rapping, even when deposits have formed to a considerable depth, and a coating having a maximum thickness of about one-eighth inch is sufficient to decrease the efficiency of the apparatus by 10% or usually more.

An object of my present invention is to provide a process of removing deposits of pitch and the like from electrical precipitator electrodes.

A second object of my invention is to provide a method of preventing the formation of troublesome deposits of pitch and the like on the collecting electrodes of electrical precipitators.

Another object of my invention is to provide an improved process of removing pitch or other suspended material from fuel gases and the like, and suitable apparatus therefor.

My invention has for further objects such other operative advantages and results as obtain in the
process and apparatus described and claimed hereinafter.

I have found that if the tubes or collecting electrodes of an electrical precipitator are flushed with tar, the formation of pitch deposits is prevented and previously existing deposits are removed. I may use coke oven tar or other tars such as water gas tar for this purpose, but I have found that especially desirable results are obtained by using mixtures of coke oven tar and water gas tar.

I have also found that tar is an excellent flushing medium for any material which tends to adhere to collecting electrodes, for reasons which will be set forth hereinafter, but it is especially desirable in the case of pitch and similar materials.

One of the greatest advantages of flushing with tar is the facility with which good distribution over the surfaces of the electrodes is maintained. When water or other limpid and volatile liquids, such as naphtha, are used for flushing, there is a tendency for it to run in streaks, leaving portions of the flushed surface unprotected. The suspensoid is thus allowed to deposit from the gas onto parts at least of the bare surface of the electrode, and the object of the flushing is defeated.

In the case of tar, however, the viscosity, surface tension, and vapor tension are such that a reasonably heavy film will remain on the electrode surfaces for hours, and under favorable conditions for days, after the flushing system has ceased to operate. For this reason flushing with tar can be conducted intermittently, if preferred, although the presence of tar as a mist in the gas or as a film on the wall of the collecting electrode in no way interferes with precipitation.

The simple device to use coke oven tar from the "dehydrating tanks", and such tar frequently contains from 1% to 3% moisture. This small amount of moisture, whether adsorbed by the tar or occurring naturally therein, appears to have the effect of increasing the electrical conductivity of the tar or tar mixture and consequently makes it possible to employ lower voltages than when absolutely dry tar is used. However, the presence of moisture in the flushing tar is not essential to my process.

A further advantage is the solvent action of the tar on the deposited pitch. The pitch mist or fog from producer gas or other gas originating from coke or coal has a composition sufficiently similar to that of coke oven tar, for example, to be soluble therein. Consequently there is a minimum tendency to deposit the pitch as a sludge in pipe lines, circulating tanks, etc.

The properties of a mixture of coke oven tar and water gas tar make it more desirable for flushing than either of the tars taken alone. The coke oven tar exerts a solvent action on the pitch, as previously stated, gives the mixture a suitable viscosity, and has a specific gravity such that it is readily separable from water if water is precipitated simultaneously with the pitch.

The other advantage of a water gas tar is to keep the mixture mobile and free-flowing at low temperatures. Pure coke oven tar becomes quite viscous and sluggish at about 20° C., while a mixture of 50% coke oven tar and 50% water gas tar has a suitable viscosity at temperatures down to 4° C., or lower. By varying the proportions of the two tars a flushing mixture with a viscosity appropriate to the prevailing temperature can readily be produced.

In spite of the difference in chemical and physical characteristics of the two tars, they are easily miscible in all proportions and show no tendency to separate on standing. The presence of water gas tar in the mixture also has a beneficial effect in minimizing the aggregation of coal dust which is always found in ordinary coke oven tar. This dust tends to form aggregates or "clouds" in pure coke oven tar; and these greatly increase the difficulty of spraying the material by clogging orifices in screens, atomizer nozzles, and the like.

Water gas tar may be used alone as a flushing medium for many types of deposit, with satisfactory results. For removing pitch, however, coke oven tar or a mixture of coke oven tar and water gas tar is usually preferable. If a supply of water gas tar is not available for diluting the coke oven tar, gas oil or other light mineral oils may be employed for this purpose.

The selected mixture of tars may be supplied to the electrical precipitator or to gas entering the collecting system by spraying, or by introducing it into troughs above or surrounding the collecting electrodes, or by other suitable procedure, but I have found that especially desirable results are obtained when the tar is atomized into gas entering the precipitator or to gas entering the precipitator as described in the preceding application of Gilbert A. Bragg, Serial No. 699,462, filed May 5, 1932.

I will now describe a preferred method of applying my improved process, with reference to the accompanying drawing, in which:

The simplest form is a view, partly in elevation and partly in vertical section, of apparatus suitable for the practice of my invention.

Fuel gas, such as producer gas containing pitch, or other gas containing suspended material to be removed, enters an electrical precipitator 1 through a pipe 2. The gas preferably passes through distributing vanes 4 and continues downward through pipes or tubes 5 constituting collecting electrodes for the precipitator. Cleaned gas is discharged through an outlet pipe 6. A discharge electrode 8 which may be a wire or in any other suitable form, extends concentrically through each of the collecting electrodes 5.

These discharge electrodes 9 are connected by means of a suitable supporting frame to a bus bar 10, which is supported in insulating compartments 12, to one or more of which lead-in wires 14 extend from a suitable source of high potential. The precipitator shell and the collecting electrodes 5 connected thereto are grounded as indicated at 15, and a high voltage discharge is produced within the tubes 5. This causes particles of pitch and the like suspended in the gas to migrate toward the tubes 5 or other collecting electrodes, on which they deposit unless prevented from so doing by a film of tar or other flushing medium.

When using the preferred mixture of tars for flushing, one of the tars, for example the water gas tar, is stored in a tank 16, to which it is delivered by a pump 18 through pipes 20, 21, 22 and 23 from the water gas or other gas. This tar is withdrawn from tank 16 through pipes 25 and 26 by pump 18, which delivers it through pipes 21 and 27 to a tar mixing tank 29. There it is mixed with coke oven tar or other constitut...
uents of the flushing medium, which may be supplied from storage tanks or any other suitable source through a pipe 30.

The coke oven tar or other flushing medium in the tank 29 may be heated, as by a steam coil 31, if desired. The flushing tar is withdrawn from tank 29 by a pump 33 and delivered through a pipe 34 and a header or distributing pipe 38 to a spray nozzle or nozzles of which there may be any desired number. It is usually desirable to provide a screen or analogous device in the line 34 to remove particles of coal dust and the like from the tar.

Any desired type and arrangement of nozzles or other distributing means may also be employed. For example, I may use one or more atomizing nozzles 37 and/or one or more ordinary spray nozzles or jets 38, and these nozzles may all be connected to the header 35, or more than one header may be employed.

If it is preferred to atomize the tar into the gas as described in the aforementioned Bragg application, atomizing nozzles 37 of the two-fluid type are preferable, and an atomizing fluid may be supplied to them through a pipe 40. As the atomizing fluid I may use steam, but I prefer to use cleaned compressed gas as I have found that the use of steam tends to cause difficulties.

Cleaned gas discharged from the precipitator 1 through the outlet 7, for example, may enter a compressor 42 through a pipe 43. It is compressed to the desired atomizing pressure, which may be 35 to 100 pounds per square inch, for example, and passes to the storage tank or holder 45, from which it is discharged as required through pipe 40 to the atomizing nozzle or nozzles.

Instead of atomizing the tar into the gas in or entering the precipitator, I may spray the tar onto the precipitator electrodes. Atomizing is usually preferable, however, as it charges the gas with a tar fog or mist, and this tar fog is precipitated from the gas along with the pitch and other material precipitated therefrom and forms a uniform film or coating on the surfaces of the collecting electrodes. In instances when deposition also occurs on the discharge electrodes and other parts of the apparatus, these also are protected by the tar.

Whether sprayed, atomized, or otherwise applied, the tar dissolves precipitated pitch, if any is present, and prevents the further formation of the troublesome and tenacious deposits previously described. The injected tar and the pitch dissolved or suspended therein collect in a sump 47 in or near the bottom of the precipitator 1, and continue through a sealed overflow line 48 to a storage sump or reservoir 50.

From this reservoir 50 the tar mixture may be withdrawn through pipe 52 by the pump 18 and returned through pipes 21 and 27 to the mixing tank 29 from which it is recirculated, or through pipes 21, 22 and 23 to the storage tank 16. Alternatively, it may be disposed of in some other manner, as by utilizing it as fuel.

When it is desired to completely remove tar and pitch from the interior of the precipitator, as for repairs or inspection, a solvent for the tar, such as solvent naphtha for example, may be employed for flushing, preferably after discontinuing operation of the precipitator.

This solvent may be withdrawn from tank 54 through pipes 55 and 20 to the pump 18, which delivers it through pipes 21 and 22 to the header 35 and one or more of the sprays connected thereto, such as spray 38. In a preferred arrangement, four or some other suitable number of atomizing sprays 37 are connected to the header 35, and two or more solvent sprays 38 are connected to a separate header communicating with pipe 22. The headers may be interconnected.

The solvent introduced through sprays 38 passes downward through the precipitator, removing tar and pitch therefrom, and collects in the sump 47 from which it is withdrawn for any desired disposal. For example it may be returned to the tank 54 for subsequent use, with or without distillation or other purification.

It will be obvious to those skilled in the art that certain modifications can be made in the several parts of my apparatus and the several steps of my process, in addition to those described by way of example hereinabove, without departing from the spirit of my invention, and it is my intention that the claims shall cover such modifications as are included within the scope thereof.

I claim as my invention:

1. The process of removing pitch from gases containing it, which comprises passing such gas between discharge and collecting electrodes maintained at a potential difference sufficient to cause migration of pitch toward the collecting electrode, introducing a non-aqueous liquid comprising a mixture of coke oven tar and water gas tar, and flushing the said collecting electrode with said non-aqueous liquid comprising a mixture of coke oven tar and water gas tar over the collecting electrode surfaces.

EARL V. HARLOW.