April 19, 1932. B. N. SEGERFELT 1,854,428

METHOD OF REMOVING MALODOROUS GASES FORMED IN
THE SULPHATE AND SODA PULP MANUFACTURE

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Fig. 1.

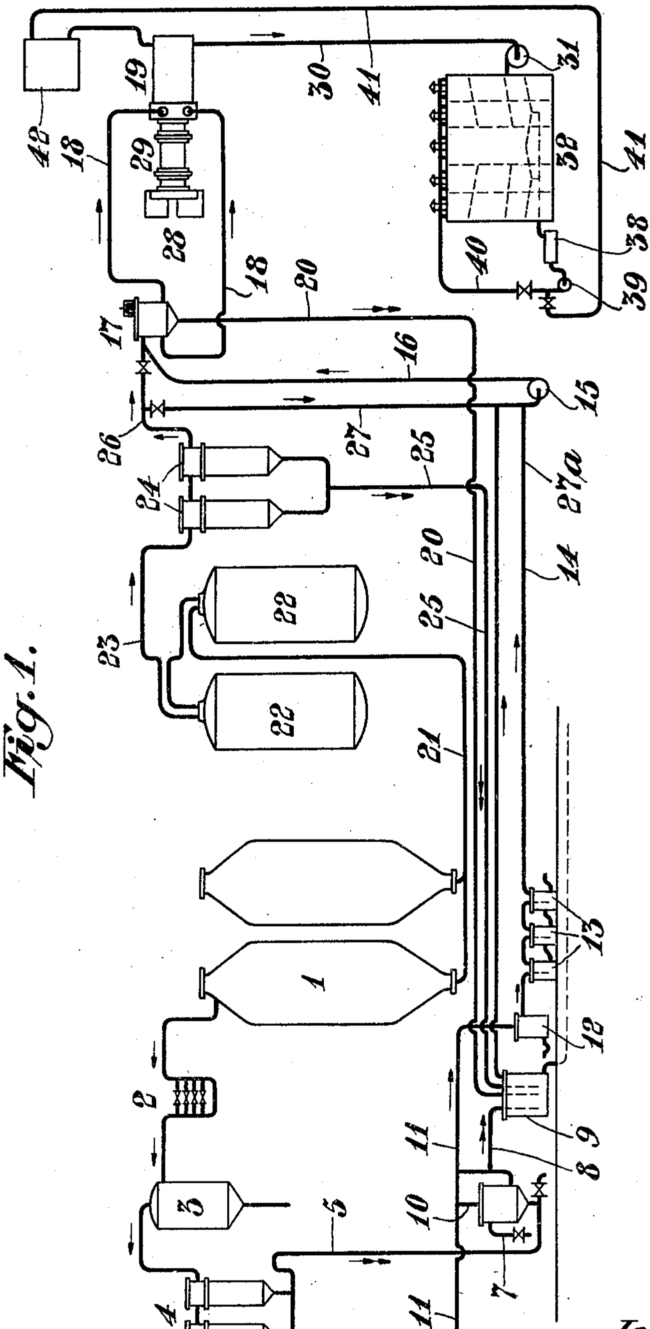

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Fig. 2.

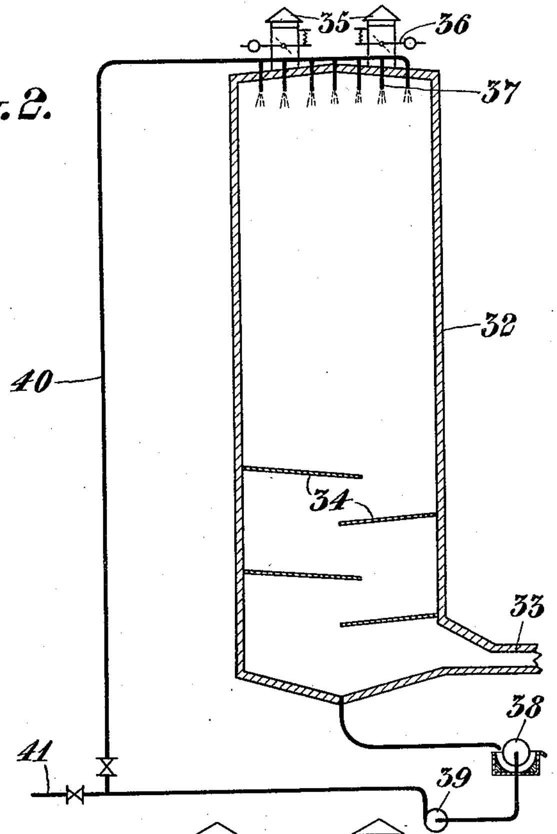
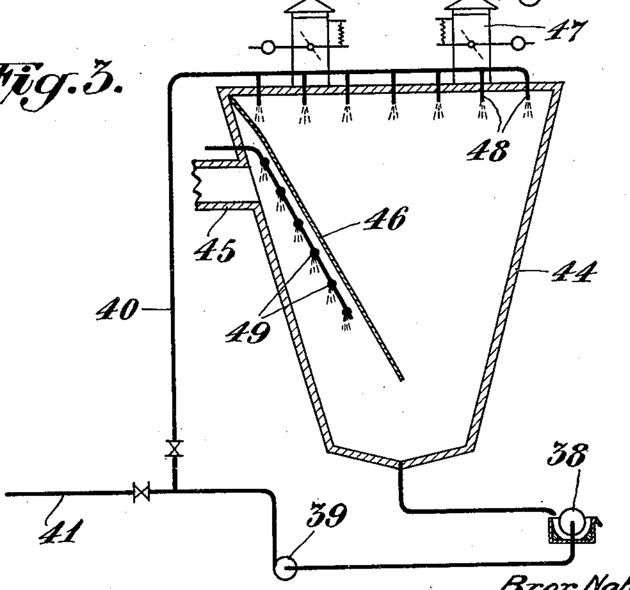


Fig. 3.



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UNITED STATES PATENT OFFICE

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METHOD OF REMOVING MALODOROUS GASES FORMED IN THE SULPHATE AND SODA PULP MANUFACTURE

Application filed February 13, 1930, Serial No. 428,093, and in Sweden January 22, 1929.

The present invention, for which application has been filed in Sweden, Jan. 22, 1929, No. 287/1929, relates to a method of eliminating the malodorous gases formed in the sulphate and soda pulp manufacture.

It is well known that during the cooking of the wood, the blowing down or gassing off of the cook, and the blowing off of the same, in sulphate and soda pulp mills, evil-smelling gases such as hydrogen sulphide, mercaptans, and other organic sulphur compounds, are formed which escape uncondensed to the atmosphere during the turpentine gassing of the digesters and during the blowing off, and besides, there are such evil-smelling gases in the fumes from melting furnaces, soda furnaces, and evaporating apparatus, which fumes also contain steam and considerable quantities of alkali dust, partly in the state of exceedingly minute dust particles of alkali salts of the above-mentioned evil-smelling organic sulphur compounds. These alkali-sulphur compounds follow the fumes out into the open, where, in the presence of water and carbon dioxide, they may become decomposed into alkali and evil-smelling gases.

Such attempts as were heretofore made to remove the smell and simultaneously to recover the alkali from the furnace gases from sulphate and soda pulp mills, failed on account of the velocity of said gases being too high, that is to say, the time was too short for an efficient treatment of the gases.

As a rule the velocity has been about 4 m. per sec. at the foot of the chimney, and the time of flow of the gases from the melting furnaces through rotary furnaces and evaporating apparatus and so forth, out into the open has been about 30 seconds. The quantity of furnace gases from a sulphate plant of medium size is usually in the neighborhood of 1,800,000 cu. m. per 24 hours, containing about 0.1 gr. alkali in the state of sodium sulphate and 8 to 13 mg. mercaptan and hydrogen sulphide per liter. When it is remembered that one forty-three millionth mg. mercaptan per cu. m. furnace gases is still quite perceptible to the smell, the difficulty will be realized with the abovementioned velocities and quantities of the gases, of entirely removing the smell by means of devices heretofore used.

Now, the present invention relates to a method of removing the smell from sulphate and soda pulp mills. The method consists principally in cooling the gases formed in the course of manufacture, or saturating such gases with water, to their dew-point and treating them with substances which oxidize, bind, or absorb evil-smelling substances in the gases. During this treatment of the gases their velocity of flow is suitably reduced to a minimum, for instance to 0.5 m. per sec. or less, and the treatment may be effected under vacuum, or at atmospheric pressure, or at a slightly higher pressure.

A preparatory step in the method according to the invention consists in conducting combustible gases formed in the manufacture to a place of combustion in the liquor recovery plant, where such gases are combusted, after which they are mixed with other gases—from melting furnaces, soda furnaces, and so forth—and are subjected to the treatment above stated. A further preparatory step in the method is that gases generated or liberated during the cooking and the gassing off, and if desired, also gases generated or liberated when the cook is blown off, are purified before combustion by absorption in alkaline liquids. For the abovementioned treatment of the gases receptacles, termed gas filters here below, are used, which are constructed in such manner that the velocity of flow of the gases in the same is reduced to a minimum, and which are provided with means for admission of liquid and/or gas.

In the accompanying drawings Fig. 1 is a flow sheet diagrammatically illustrating the treatment according to the present method of the gases from a sulphate or soda pulp mill. Fig. 2 shows diagrammatically one construction of the gas filter, and Fig. 3 shows a second construction of the filter.

Referring to Fig. 1, 1 denotes the digester from which, when gassing off in order to recover turpentine, the gas is conducted to a gassing battery 2 consisting of a plurality of small pipes provided with valves, which latter are opened successively during the gassing off, so as to prevent too violent an escape of gas from the digester.

The gas is conducted from the gassing battery 2 to a liquor trap 3 in which black liquor possibly entrained by the gas is separated, and thence to a gas cooler 4 in which the gas is cooled down. The condensate flows from the bottom of said cooler 4 through a pipe 5 to a Florence flask 6, in which the turpentine is separated from accompanying water. The turpentine is drained through the pipe 7, and the water is drained through the pipe 8 to a condensate receptacle 9. The Florence flask is provided with an air-tight cover, and the gas flows from the flask through the pipe 10 to a pipe 11 through which gas flows from the cooler 4 to an absorption vessel 12 which contains water, or a solution suitable for washing gases, and from said vessel the gas then flows through one or more absorption vessels 13 containing alkaline liquid, preferably white liquor, to which organic or inorganic substances, such as evaporated black liquor, or ordinary salt, which increase its viscosity, have been added. The absorption vessels 12 and 13 may be of the ordinary washing flask type, but they may also be made as so-called disintegrator absorption apparatus in which the gases are mechanically mixed with the liquid used. From the absorption vessels 13 the gas is conducted through the pipe 14 by means of the blower 15, and through the pipe 16 to the explosion filter 17 and thence through the pipe 18 to the place of combustion, which in the instance illustrated, is the evaporator 19. From the explosion filter 17 condensate passes through the pipe 20 to the condensate receptacle 9.

When the cook is blown off through the pipe 21 to the diffusers 22, liberated gases flow through the pipe 23 to coolers 24 from which condensate flows through the pipe 25 to the condensate receptacle 9, while the gases flow through the pipe 26 to the explosion filter 17. The pipe 26 is connected through a pipe 27 to the suction side of the blower 15, so that the firstnamed pipe can be evacuated after each blowing. Connected to the suction side of the blower are preferably also all other receptacles in the mill which contain malodorous solutions, as shown for instance in respect of the condensate receptacle 9 and the pipe 27*a* leading therefrom. If deemed suitable there may be inserted in the pipe 26 from the cooler 24 absorption vessels corresponding to the absorption vessels 13 and containing a suitable absorption liquid, for the purpose of purifying the gas from the diffusers by absorption before the gas reaches the explosion filter 17. Said filter consists of a closed receptacle provided with a safety valve, and in which the gas has to pass through a layer of iron pieces or stones placed on a grate. The explosion filter serves to prevent ignition and explosion of the gas in the pipes leading to the explosion filter.

The gas flowing from the explosion filter 17 through the pipes 18 is ignited and combusted in the evaporator 19 and is here mixed with the gas flowing from the melting furnaces 28 through the rotary soda furnace 29, and in the evaporator these gases evaporate the black liquor supplied to the evaporator, after which the gases which contain, besides steam, alkali dust and other ash constituents, as well as non-combusted malodorous substances or gases, are conducted through the pipe 30 and the blower 31 to the gas filter 32 for further treatment.

In the gas filter the velocity of flow of the gas shall be reduced to a minimum, and at the same time the gas is to be cooled, or saturated with water or other liquids, so that the dew-point of the gas at the prevailing temperature is reached. Owing to the reduced velocity, and owing to the cooling or saturation to the dew-point, the alkali dust sticks to the dewdrops and is separated together with said drops from the gas and passes downwards as condensate. The gas shall also be treated with oxidizing, binding or absorbing substances which oxidize, bind or absorb the remaining malodorous constituents in the gas. These substances may be air, steam, sulphur dioxide, chlorine, water, solutions of, for instance, copper sulphate and other salts, black liquor, sulphite waste liquor, soda or caustic soda lye, and particularly, solutions of hydrocarbons belonging to the groups of terpenes or camphors, or derivatives or addition compounds of such hydrocarbons.

When treating the gases of combustion with terpenes or camphors aromatically smelling organic substances are formed, and to some extent free sulphur, and the reaction is best performed if the said hydrocarbons are dissolved or emulsified in an alkaline water solution of high viscosity, and if the reaction takes place at a temperature between +20° C. and +120° C.

In the gas filter 32, an embodiment of which is diagrammatically illustrated to a larger scale in Fig. 2, and which may consist, for instance, of a high receptacle having a volume of about 4000 cu. m. for a gas quantity of 1,000,000 cu. m. per 24 hours, the gas is introduced through the opening 33 at the bottom of the filter. Having entered the filter the gas is forced by cross partitions 34 to spread over the entire area, so that the velocity is decreased, so that when the gas has passed the last partition its velocity is below 0.5 m. per sec. The gas is discharged at the top of the filter through suitably spaced discharge devices or openings 35, which may be provided with automatically controlled dampers 36 which open at an excess pressure in the filter of for instance 100 mm. water column. The gas may also be discharged and the treatment in the filter may be performed at atmospheric pressure, or under vacuum, in which latter case the gas is exhausted by means of suitably placed fans.

Through atomizing sprayers or nozzles 37 arranged at the top of the filter a suitable absorption medium of those above mentioned, for instance black liquor, is sprayed into the filter against the direction of flow of the gas and in the form of a fine drizzle. The black liquor and such condensate as might have precipitated from the gas, as well as the alkali dust carried along by such condensate or black liquor, collect in the funnel-shaped bottom of the filter from which the liquid flows to a filter or water removing cylinder 38 where the alkali dust is separated from the liquid after which the dust is conducted to the melting furnace. The purified liquid—the black liquor—flows to a pump 39 which returns the liquor through the pipe 40 to the nozzles 37, and also returns the excess liquor through the pipe 41 to the black liquor receptacle 42, from which the black liquor is supplied in the usual manner to the evaporator 19. It will be understood that according to circumstances some other of the abovementioned absorption liquids may be used, instead of black liquor, and that a suitable number of nozzles 37 may be adapted to introduce a suitable gas of the kind above stated.

According to the embodiment illustrated in Fig. 3, the gas filter consists of a funnel-shaped receptacle 44, at the top of which the gas is introduced through the opening 45, after which it is caused by the partition 46 to flow down towards the bottom of the filter.

The gas is then allowed to spread upwards and to fill an increasingly greater volume, so that at the top of the receptacle the velocity is decreased to 0.5 m. per sec. or lower, after which the gas escapes through the openings or chimneys 47. Through the nozzles 48 air or other gaseous substance and/or an oxidizing or absorbing liquid may be sprayed into the gas against the direction of flow and through the nozzles 49 in the direction of flow. The condensate, or the condensate and the injected liquid, collects at the bottom of the receptacle and are conducted, as in Fig. 2, to the filter 38, after which it is reintroduced by means of the pump 39 in the filter through the pipe 40, and the excess is conducted through the pipe 49 to the liquor regeneration.

I claim:

1. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in bringing gases formed in the manufacture to their dew-point, and treating said gases with hydrocarbons belonging to the terpene and camphor groups.

2. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in reducing the velocity of flow of gases formed in the manufacture to 0.5 m. per sec. at most, bringing said gases to their dew-point, and treating said gases with hydrocarbons belonging to the terpene and camphor groups.

3. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in bringing gases formed in the manufacture to their dew-point, and treating said gases at other than atmospheric pressure with hydrocarbons belonging to the terpene and camphor groups.

4. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in bringing gases formed in the manufacture to their dew-point, and treating said gases with hydrocarbons belonging to the terpene and camphor groups contained in an alkaline water solution.

5. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in bringing gases formed in the manufacture to their dew-point, and treating said gases at a temperature between 20° C. and 120° C. with hydrocarbons belonging to the terpene and camphor groups.

6. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in conducting combustible gases formed in the manufacture to a place of combustion in the liquor recovery, combusting said gases, bringing such combusted gases and other gases formed in the manufacture to their dew-point, and treating said gases with hydrocarbons belonging to the terpene and camphor groups.

7. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in purifying gases formed during the digestion and gassing off and gases formed and liberated when the cook is blown off by absorption in alkaline liquids of high viscosity, conducting said gases to a place of combustion in the liquor recovery, combusting said gases, bringing such combusted gases and other gases formed in the manufacture to their dew-point, and

treating said gases with hydrocarbons belonging to terpene and camphor groups.

8. The method of removing malodorous gases formed in the sulphate and soda pulp manufacture, which consists in bringing gases formed in the manufacture to their dew-point, and treating said gases with hydrocarbons belonging to the terpene and camphor groups and waste liquor from the pulp manufacture.

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