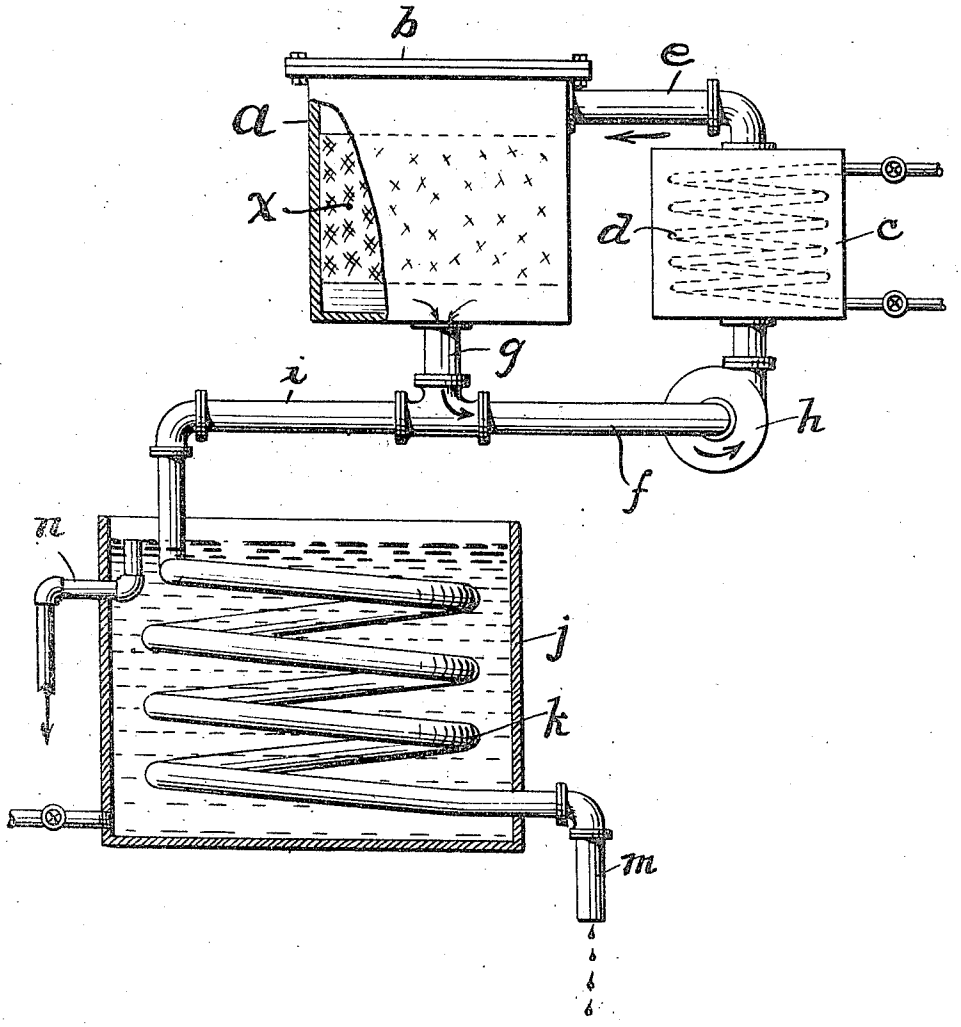
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PROCESS FOR RECOVERING SOLVENT FROM SMOKELESS POWDER.

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PROCESS FOR RECOVERING SOLVENT FROM SMOKELESS POWDER.

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To all whom it may concern:

Be it known that I, FRANCIS I. DU PONT, a citizen of the United States, residing at Wilmington, county of New Castle and State of Delaware, have invented a new and useful Improvement in Process for Recovering Solvent from Smokeless Powder, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, which form a part of this specification.

In the recovery of solvent, such as ether and alcohol, from materials such as smokeless powder, it is customary to circulate air, by means of a mechanical blower or by difference of temperature, successively through the recovery chamber, a condenser cooled with a coil containing circulating cold water or refrigerated brine, a heating chamber heated by a steam or hot water coil, and thence back to and through the recovery chamber. The recovered solvent collects on the outside of the coil of pipe in the condenser and drips out from an outlet as fast as it collects.

This system is open to a number of objections, some of them quite serious. During the operation there cannot exist in the system an atmosphere of pure vapor, as the condensing coil will, by the shrinkage due to the vapor being condensed out of the air, always suck in a little air through the recovered solvent exit or through any other leak that may exist in the apparatus, this air being circulated around continuously with the vapor. The only condition under which this would not happen would be an insufficiency of the condenser, in which case some of the vapor would escape at the solvent outlet and be lost. Again, in the usual system, the heater and the condenser are in the same system and are constantly bucking against each other. Hence there is difficulty in maintaining the powder mass at the desired temperature; and any attempt to unduly increase the circulation will merely transfer heat from the heater to the condenser in a necessarily wasteful manner. Again, inasmuch as the condenser must operate upon a certain volume of air as well as upon the vapor, a relatively low temperature must be maintained in the condenser, ice cooling being necessary.

The objects of my invention are: to exclude air from the circulating system so as to maintain therein an atmosphere of pure vapor; to maintain the powder mass with certainty at the desired temperature; to dispense with the necessity for ice cooling; to avoid the bucking against each other of the condenser and the heater; to avoid waste of heat and waste of cooling power, thereby effecting a more economical carrying out of the operation; to expedite the process; and to avoid conditions rendering possible imperfect condensation of the solvent.

A convenient means for carrying out my new process is illustrated in the accompanying drawing, which shows, also, a preferred embodiment of my apparatus invention. The single figure is a view of the apparatus in sectional elevation.

The recovery chamber *a*, containing a layer of smokeless powder or similar material *x*, is provided with a cover *b*, which is maintained closed during the operation. A heating chamber *c* contains a coil *d* through which is circulated hot water or steam. A pipe *e* connects the heating chamber *c* with the upper part of the recovery chamber *a* and pipes *f* and *g* connect the heating chamber *c* with the bottom of the recovery chamber *a*, affording an endless path for the circulation of air and vapor, this circulation being induced in the direction of the arrows by means of a fan or blower *h* interposed in the pipe *f*.

An overflow passage *i* connects with pipes *f* and *g* at their junction and communicates with a condenser, the latter comprising a vessel *j* containing water in which is immersed a coil of pipes *k* communicating with the passage *i* and having at its lower end an outlet *m* for the escape of air or condensed vapor, as hereinafter described. An overflow pipe *n* is provided for the water.

It is necessary to keep the water in the condenser only at a temperature below the boiling point of the liquid which is being recovered.

The chamber *c* should be heated to the point required to maintain the circulating vapor above the coiling point of the liquid which is to be resevered. In the case of a mixed solvent, like ether and alcohol, good results are obtained by maintaining the tem-

perature of the circulating vapor distinctly above the boiling point of the ether but below the boiling point of the alcohol.

The operation is as follows:

Upon starting, the air in the endless circulating system is first heated. Owing to the fact that the condenser is not in the endless circulating system, the material *x* in chamber *a* soon becomes heated throughout its mass. As soon as sufficient vapor is evolved from the mass, all the air is expelled by the vapor which is continually being driven off from the mass by the heat. This air is expelled through the overflow pipe *i* and coil *k* and escapes at the recovered solvent exit *m*. After the expulsion of the air, which takes place almost immediately after starting, there is established a circulation of pure vapor free from air, which, having a higher specific heat than air, is more efficient. The vapor constantly being displaced by the vapor continually being driven off passes continuously into the condenser.

The advantages of the above described system may be stated as follows:

Inasmuch as the condenser is excluded from the endless circulating system, the cold coil is not bucking against the hot coil, and there is therefore no difficulty in maintaining the powder mass at any desired temperature, as a large amount of air or vapor may be circulated through the system without any waste of heat or cooling power. In no event can there be any transfer of heat from the heater to the condenser in a wasteful manner.

Since, after the displacement of the air at the start of the operation, no other air can pass or leak into the system, the condenser operates only upon pure vapor and condensation takes place as soon as a temperature is reached below the boiling point of the liquid which is being condensed; ice cooling, therefore, being unnecessary.

By reason of the foregoing conditions, waste of heat or of cooling power is avoided, the operation is carried on expeditiously and economically, and no conditions are present rendering possible imperfect condensation of the solvent.

Having now fully described my invention, what I desire to claim and protect by Letters Patent is:

1. The process of recovering solvent, such as alcohol and ether, from smokeness powder and similar material, which consists in gradually vaporizing the solvent contained in the material, segregating a part of the vaporized solvent and subjecting only the part segregated to the action of a cooling medium to effect its condensation, and returning to the material the uncooled remainder of the vaporized solvent.

2. The process of recovering solvent, such as alcohol and ether, from smokeless powder and similar material, which consists in establishing an endless circulation of fluid through said material and simultaneously heating said fluid, thereby gradually vaporizing the solvent contained in the material, affording an outlet for the excess heated vapor thus constantly being formed and subjecting only said escaped excess vapor to the influence of a cooling medium.

3. The process of recovering solvent, such as alcohol and ether, from smokeless powder and similar material, which consists in establishing an endless circulation of fluid through said material and simultaneously heating said fluid, thereby gradually vaporizing the solvent contained in the material, and constantly discharging from the material a volume of vapor in excess of that admitted thereto, subjecting only said discharged excess volume of vapor to the influence of a cooling medium, and applying heat to, and returning to the material, the uncooled volume of vapor.

4. The process of recovering solvent, such as alcohol and ether, from smokeless powder and similar material, which consists in establishing through the powder an endless flow of the vaporized solvent that has been driven off from the powder and continuously applying heat to the flowing vapor, thereby continuously driving from the powder additional vapor, affording an outlet from the endless vapor path for the excess of vapor thus continuously forming, and cooling only said excess vapor thus escaping from said endless vapor path, whereby the vapor constantly passing into the powder is vapor that has not been previously cooled.

5. The process of recovering solvents, such as alcohol and ether, from smokeless powder and similar material, which consists in maintaining, by circulation through a mass of the powder, an atmosphere consisting entirely of the vapors of said solvent, supplying by means of a heater interposed in the circulating circuit the heat units which have been abstracted by the conversion of the solvent from the liquid to the gaseous state, conducting the excess of vapor continually formed by the addition of aforesaid heat units away from the circulating system, and condensing the vapors thus conducted from the circulating system.

In testimony of which invention, I have hereunto set my hand, at Wilmington, Delaware, on this 3rd day of January, 1917.

FRANCIS I. DU PONT.