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CHEMICAL CLEANING APPARATUS

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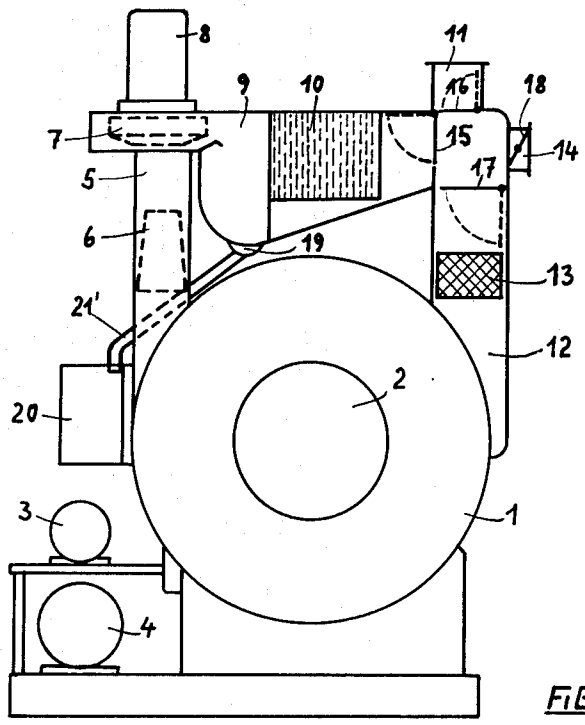

FIG. 1

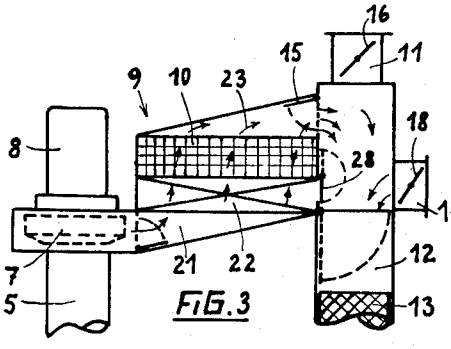

FIG. 3

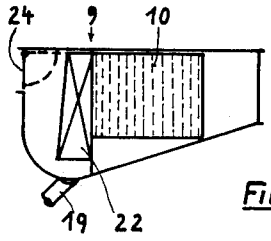

FIG. 2

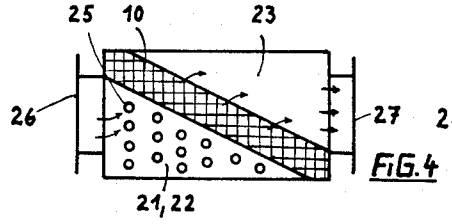

FIG. 4

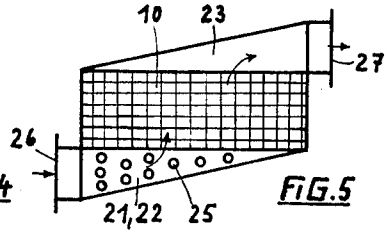

FIG. 5

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CHEMICAL CLEANING APPARATUS

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6 Claims. (Cl. 34—80)

The invention relates to a chemical cleaning apparatus with an adsorber, for example a device containing activated charcoal, for the recovery of the solvent.

A familiar dry-cleaning method is to condense the solvent inside the cleaning apparatus during the drying of the goods, which are still damp with solvent, by heating and then cooling the drying air. For this purpose, both finned, water-cooled heat exchangers and spray coolers are used.

With this method, the recovery efficiency depends on the lowest air temperature attainable. The gaseous solvent still remaining in the air at this temperature at the end of the drying process is wasted when the goods are aired; and this gas may be present in greater or less quantities, according to the nature of the solvent used. To avoid this loss, it is customary in chemical cleaning to trap these gaseous residues of solvent, by filtration, in a central activated-charcoal adsorber. With equipment of this kind, the cleaning apparatus retains its original design. Thus it contains a cooler, in which a proportion of the solvent is condensed and led away to the water separator. The adsorber is fitted to follow this cooler. It will be apparent that a large quantity of the activated charcoal must be present in this equipment, if the solvent encountered during the day is to be effectively retained, because the activated charcoal in this existing kind of device is usually not regenerated until evening, or even until several days have passed. As a result, the individual dry cleaning apparatus must have a fairly large tank for the solvent in liquid form, because a certain amount of solvent from each charge is retained by the activated charcoal. Moreover, this kind of installation gives rise to additional overhead expenses, besides occupying more space.

To avoid these difficulties, it has already been suggested to combine an adsorber containing activated charcoal, as a single-charge adsorber and accessory, with the chemical cleaning apparatus. Here a chemical cleaning apparatus of the usual kind, that is to say without adsorber, is first run with the normal circulation required for the drying phase of the cleaning process, until the maximum amount of solvent has been recovered through the normal cooler. As soon as about one-third to one-half of the recovery time has elapsed, the circulation is interrupted and the vapor that has not yet been condensed in the cooler is taken to the activated-charcoal adsorber. In this way, the total recovery time can be materially reduced.

However, all these existing arrangements are based on the fact that hitherto trichlorethylene or perchlorethylene has usually been employed as the solvent. If, now, solvents are used that have a low boiling point, it is no longer possible, owing to the great volatility of such solvents, to delay the recovery of the appreciably higher content of gas in the waste air until this has left the cleaning plant.

Furthermore, with solvents of low boiling point, the gas concentrations in the air flowing to the air cooler are still so high that this reduces the capacity of the air for solvent adsorption during re-heating and so has a bad effect on the drying performance.

The purpose of the invention is therefore to design

the recovery equipment of a conventional dry cleaning apparatus so that not only the normal solvent can be used, but also solvents of low boiling point, while keeping losses as low as possible. The invention thus takes account of the fact, for example, that considerable advances can be achieved if trichlorotrifluoroethane or some chemically related substance be used as the solvent. Surprisingly enough, it has been found that ordinary chemical cleaning apparatus need not be basically redesigned to achieve the desired object; for with this invention all that is needed is for the adsorber, and more particularly an activated-charcoal unit, to be fitted in place of the usual cooler, inside the cleaning apparatus, between the drum draw-off and the exhaust connection. An arrangement of this sort makes it possible to adsorb the solvent leaving the cleaning drum immediately, so that it has no opportunity to escape at positions where it cannot be condensed. If one connects the outlet pipe of the adsorber to the drum input in accordance with the invention, the apparatus can then be run with the adsorber included in a closed circulation system.

It is of particular advantage to have the adsorber preceded by a dual-purpose cooler, so that in operating phase the solvent drawn off from the drum can be precondensed and in another operating phase the solvent recovered from regeneration of the adsorber charge (activated charcoal) can be condensed in the same cooling zone. With an arrangement of this particular kind it is also possible to use solvents of any desired boiling point. If the solvent has a very low boiling point, the yield from pre-condensation in the dual-purpose cooler is itself high. In addition to this, there is considerable economy in space and money if one can use the same cooler for different purposes at different times.

It is advantageous, again, to insert shut-off valves in the inlet pipes supplying the adsorber and the dual-purpose cooler. In this way, when the adsorber is to be regenerated, it becomes possible to carry out the regeneration during stages other than the drying cycle in the operation of the cleaning apparatus. For example, it is found to be an advantage to proceed with regeneration during the washing stage of the cleaning apparatus, when the adsorber evaporation is confined within the casing in which the adsorber is housed.

In one embodiment of the invention, the dual purpose cooler is fitted below the adsorber. It is expedient for the bed of activated charcoal to extend more or less diagonally through the recovery chamber in one layer bounded by parallel end walls, which enables the gas inflow and outflow to follow the same direction. The intake space for the vapor that is to be condensed, which lies below the layer of activated charcoal, should preferably be designed as a wedge-shaped front compartment converging toward the adsorber, and the outlet passage above this charcoal layer may be of similarly wedge shape to constitute a diverging rear compartment. In this case, the cooling mechanism of the dual-purpose cooler, for example pipes for a heat exchanger, can be accommodated in the front compartment.

The invention is diagrammatically illustrated by way of example in the accompanying drawing, in which

FIGURE 1 is a front elevation of a chemical cleaning apparatus according to the invention;

FIGURE 2 is a side elevation of an adsorber preceded by a dual-purpose cooler;

FIGURE 3 shows another embodiment of the adsorber with adjoining dual-purpose cooler; and

FIGURES 4 and 5 show two embodiments of adsorbers with dual-purpose coolers, in side elevation.

The embodiment shown in FIGURE 1 represents a basically conventional dry cleaning apparatus; having a drum, 1, in which the textile goods to be cleaned are

placed through charging door 2. The reference numerals 3 and 4 represent the two motors which provide the fast and slow drives for the drum.

For the recovery of the solvent from the water/solvent, vapor formed in the drum, the vapor is drawn during the drying cycle by fan 7 through a duct forming an extraction passage 5 and led into adsorber 9–10. In extraction passage 5 there is a trap 6 for impurities. Element 8 is the motor which drives fan 7. In ordinary cleaning apparatus, the place of adsorber 9 is taken by a large cooler. The space allowed for this cooler is large enough to enable the adsorber to be mounted therein instead of the cooler. In the embodiment shown in FIGURE 1, the adsorber consists of a container 10, charged with activated charcoal. The solvent is adsorbed in the bed of activated charcoal 10 while the air circulated by the blower 7 passes through and is taken either to exhaust port 11 or to a duct forming an entrance passage 12 for return to the cleaning drum 1. There is also an intake port 14 for the introduction of fresh air. In the first place, therefore, it is possible to draw in fresh air from port 14, by means of fan 7. This fresh air is brought to the required temperature in heater 13 before it reaches drum 1. If shut-off valves 15 and 16 are opened, the air passing through adsorber 9–10 is led into the open, so that fresh air should be fed to drum 1; otherwise a vacuum would be created in drum 1 which, with many cleaning processes, is in fact actually desirable. However, shut-off valve 16, shown open in FIGURE 1, can also be moved to the closed position, whereupon it becomes possible, by opening shut-off valves 15 and 17, to set up a recirculation system, the air that passes the adsorber then being fed back to drum 1 again. This air can be replaced by fresh air, for which purpose damper 18 is provided. This enables the amount of fresh air entering to be controlled. Upon completion of the recovery process, it is advisable to close shut-off valves 17 and 18 and to open shut-off valves 15 and 16, so that all the gases and vapors are drawn from the drum, led through adsorber 9–10 and discharged into the open through exhaust port 11.

According to the invention, adsorber 9–10 can be used both as a single-charge and as a day's-run adsorber. According to the way it is used, adsorber 9–10 must contain an appropriate quantity of adsorptive material—in particular, activated charcoal.

The solvent retained in adsorber 10 is evaporated in the usual way with water vapor. The condensate is taken by way of conduit 19 through a drain pipe 21' into the water separator 20 of the cleaning apparatus. When adsorber 10 is used as a single-charge adsorber, this regeneration is best carried out during some stage in the operation of the cleaning apparatus when the recovery gear is not needed. This applies in particular to the washing stage. Container 9, which surrounds adsorber 10, may be suitably sealed, so that the vapor entering adsorber 10 (for the sake of simplicity, the connecting pipes are not shown in the drawing) cannot get into the other passages and pipes of the cleaning apparatus. The embodiment shown in FIGURE 2 represents a combination of adsorber 10 and a dual-purpose cooler, 22, within adsorber casing 9. This cooler 22 serves to cool the incoming gases and vapors and bring about precondensation; in addition, it helps condense the solvent-laden water vapor which has traversed the adsorber 10 during the regeneration phase. In this way, at least part of the solvent is recovered and led into water separator 20, so the supply of solvent can be reduced. Reference numeral 24 represents a shut-off valve which serves to close the feed connection to adsorber 9–10. The flap 24 is closed during the regeneration of adsorber 9–10.

In the embodiments shown in FIGURES 3 to 5, dual-purpose cooler 22 is mounted directly below adsorber 10. This arrangement, wherein a front compartment 21

containing the cooler 22 and a rear compartment 23 leading to duct 12 are defined by the parallel end walls of charcoal bed 10 and respective inclined wall portions of the connection 9, affords a high recovery efficiency on account of the increased surface area of the charcoal layer provided by the relative inclination of bed 10 and duct 9. In the embodiment of FIGURE 3, the air coming from fan 7 is directed by the wedge-shaped front compartment 21 upwards into cooler 22 and on into adsorber 10. The adsorber 10 is overlain by rear compartment 23, which diverges in the form of a wedge. From the passage 23, the cleaned air can either return into the drum or escape into the open through exhaust connection 11.

This principle of keeping the vapor inflow and outflow in one and the same direction can also be observed, as in the embodiment shown in FIGURE 4, by having the layer of activated charcoal 10 in the adsorber passing diagonally through the recovery chamber. The vapor enters through connection 26 and is pre-condensed in dual-purpose cooler 21–22, which tapers into a wedge shape, before being led through activated charcoal in the container 10 and taken away from the recovery container by way of outlet 27. In this version, the pipes of a heat exchanger, shown at 25, are fitted in the cooler.

It is also possible, however, within the scope of the invention, to construct the dual-purpose cooler on the lines of other known types. For example, one can employ spray cooling or cooling of the so-called "enclosed" type, with a number of fins passing through the cooling chamber. The vaporizer of a compression refrigerator unit may also be used with advantage.

FIGURE 5 shows another embodiment of adsorber 10 in which the cooling unit 25 is fitted inside the tapered, wedge-shaped intake passage, 21. Here again, the gases enter and leave the adsorber without changing direction, so that the recovery can take place within the most confined space possible. This, again, affords the possibility of simply replacing the recovery units of ordinary cleaning apparatus with means according to the invention, without the need for any other modifications to the apparatus.

In the embodiment illustrated in FIGURE 3, it is also possible and advantageous to connect dual-purpose cooler 22 directly to drum inlet passage 12 through a bypass aperture 28, which can be closed. With this arrangement, the air cooled in cooler 22 can at once be led directly into drum 1, without having to pass through adsorber 10. Again, both apertures 15 and 28 can be left open, so as to divide the stream of air, one part being taken through absorber 10 and the other through aperture 28.

We claim:

1. A dry-cleaning machine comprising a housing; a rotatable drum in said housing for articles to be treated with a volatile solvent; duct means in said housing forming an extraction passage for said drum, an entrance passage for said drum and a connection between said passages; blower means in said extraction passage; and adsorber means for volatile solvent in said connection including a container in said housing for a charge of activated charcoal, said duct means being provided in the housing with a closable air-intake port and an exhaust port at the junction of said connection with said entrance passage and being further provided with valve means selectively operable for directing vapors from said drum, driven by said blower means through said adsorber means, into the atmosphere through said exhaust port in a first position of said valve means and into said entrance passage for recirculation through said drum in a second position of said valve means.

2. A dry-cleaning machine comprising a housing; a rotatable drum in said housing for articles to be treated with a volatile solvent; duct means in said housing forming an extraction passage for said drum, an entrance passage for said drum and a connection between said

passages; blower means in said extraction passage; cooler means in said housing disposed in said connection; and adsorber means for volatile solvent in said connection including a container in said housing for a charge of activated charcoal, said adsorber means being disposed downstream of said cooler means, said duct means being provided in said housing with a closable air-intake port and an exhaust port at the junction of said connection with said entrance passage and being further provided with valve means selectively operable for directing vapors from said drum, driven by said blower means through said cooler means and said adsorber means, into the atmosphere through said exhaust port in a first position of said valve means and into said entrance passage for recirculation through said drum in a second position of said valve means.

3. A dry-cleaning apparatus comprising a rotatable drum for articles to be treated with a volatile solvent; duct means forming an extraction passage for said drum, an entrance passage for said drum and a connection between said passages; blower means in said extraction passage; cooler means in said connection; and adsorber means for volatile solvent in said connection including a container for a charge of activated charcoal, said adsorber means being disposed downstream of said cooler means, said duct means being provided with a closable air-intake port and an exhaust port at the junction of said connection with said entrance passage and being further provided with valve means selectively operable for directing vapors from said drum, driven by said blower means through said cooler means and said adsorber means, into the atmosphere through said exhaust port in a first position of said valve means and into said entrance passage for recirculation through said drum in a second position of said valve means, said connection being provided with a selectively closable bypass from said cooler means to said entrance passage.

4. A dry-cleaning apparatus comprising a rotatable drum for articles to be treated with a volatile solvent; duct means forming an extraction passage for said drum, an entrance passage for said drum and a connection between said passages; blower means in said extraction passage; cooler means in said connection; and adsorber means for volatile solvent in said connection including a container for a charge of activated charcoal, said adsorber means being disposed downstream of said cooler means, said duct means being provided with a closable air-intake port and an exhaust port at the junction of said connection with said entrance passage and being further provided with valve means selectively operable for directing vapors from said drum, driven by said blower means through said cooler means and said adsorber means, into the atmosphere through said exhaust port in a first position of said valve means and into said entrance passage for recirculation through said drum in a second position of said valve means, said container being

bounded by parallel end walls and wherein said connection including a pair of wall portions inclined with reference to said end walls and defining therewith a converging front compartment accommodating said cooler means and a diverging rear compartment leading toward said exhaust port.

5. An apparatus as defined in claim 4 wherein said cooler means is disposed directly below said container.

6. A dry-cleaning apparatus comprising a rotatable drum for articles to be treated with a volatile solvent; duct means forming an extraction passage for said drum, an entrance passage for said drum and a connection between said passages; blower means in said extraction passage; cooler means in said connection; and adsorber means for volatile solvent in said connection including a container for a charge of activated charcoal, said adsorber means being disposed downstream of said cooler means, said duct means being provided with a closable air-intake port and an exhaust port at the junction of said connection with said entrance passage and being further provided with valve means selectively operable for directing vapors from said drum, driven by said blower means through said cooler means and said adsorber means, into the atmosphere through said exhaust port in a first position of said valve means and into said entrance passage for recirculation through said drum in a second position of said valve means, said apparatus further comprising a water separator, said cooler means being provided with a drain leading to said water separator.

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