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METHOD AND APPARATUS FOR THE CONDENSATION  
IN DRY-CLEANING MACHINES  
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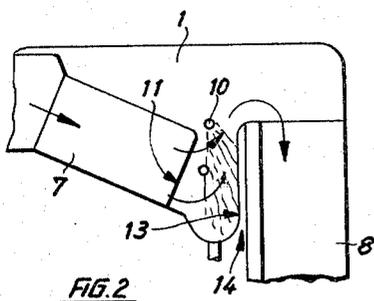
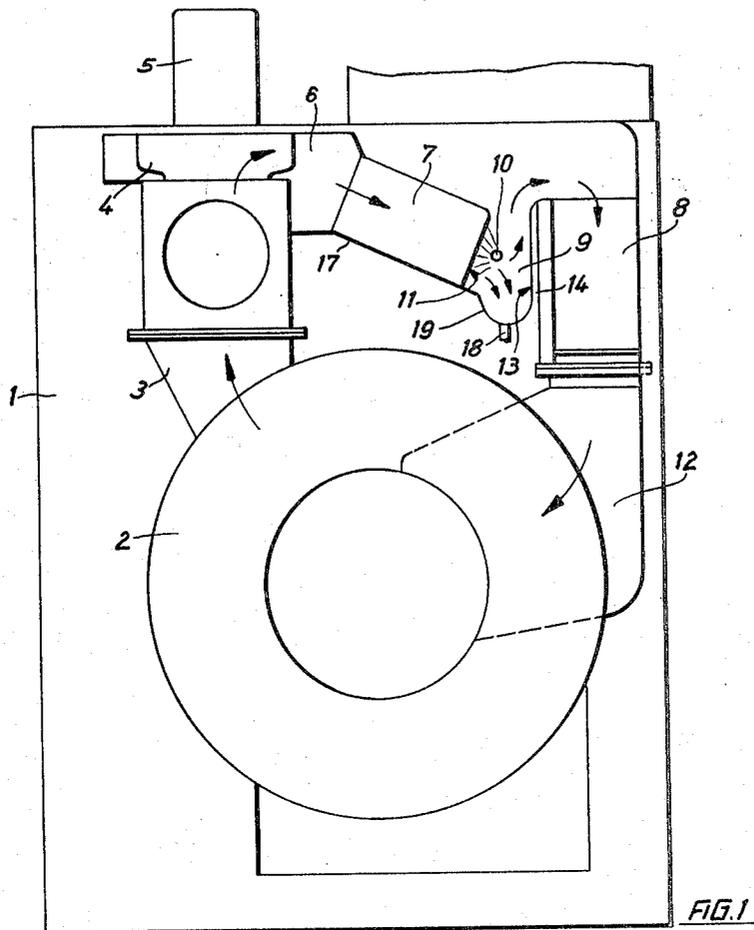


FIG. 2

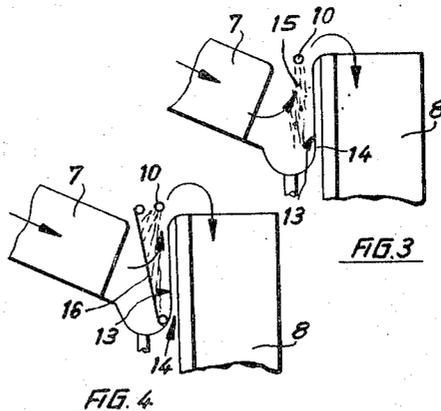


FIG. 3

FIG. 4

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**METHOD AND APPARATUS FOR THE CONDENSATION IN DRY-CLEANING MACHINES**

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The invention relates to a method and apparatus for the condensation of the vapours and gases evolved in dry-cleaning machines, using spraying-nozzle cooling, in which a finely or very finely divided liquid is sprayed into the gas stream.

In dry-cleaning machines, devices which are operated by the spraying-nozzle method or in which a closed condenser is used, are predominantly used. The spraying-nozzle method employs a closed compartment through which passes the gaseous mixture of air, solvent and water vapour coming from the cleaning drum, and a fine mist is sprayed into the said gas stream thus causing condensation of the solvent present therein.

The closed-condenser system also comprises essentially a closed compartment through which the gas is passed. The compartment contains baffles or lamellar surfaces on which the gases of the solvents are deposited and condensed.

It has been found that the vapours are insufficiently condensed if the recovery period in dry-cleaning machines is reduced as would be desirable. On the other hand, it is inconvenient to increase the dimensions of the areas of condensation for the purpose of reducing the recovery time in the condenser. The fact that with adequately constructed condensers it happened frequently that water vapour as well as the solvent vapours escaped from the cleaning drum, was also felt to be a disadvantage. Part of the water present in the goods to be cleaned is thus removed therefrom and is likewise condensed in the condenser. The air returned to the drum is, however, extremely dry so that it is unable to reintroduce water into the goods. In consequence, the goods are excessively dried with resulting damage and complaints.

It is the object of the invention to increase the efficiency in the condenser to a substantial extent at minimum cost and without substantially increasing the dimensions of the conventional condensers, so that the recovery time is perceptibly reduced and excessive drying of the goods is at the same time avoided. It was particularly difficult to find an answer to this problem, since the two problems posed are contradictory and it is generally assumed that an increased efficiency of the condenser would necessarily result in excessive drying of the goods, or, conversely, that it would be impossible to reduce the condensation time if excessive drying of the goods was to be avoided.

The invention is based on the known process for the condensation of the vapours and gases evolved in dry-cleaning machines using a closed condenser, in which the main condensation takes place. In accordance with the invention, the answer to the problem is to spray, at least temporarily, a finely divided liquid into the stream of gas or air escaping from the condenser.

As mentioned previously, it is known to spray a finely divided liquid into a gas stream. It is, however, not known to carry out this spraying process in the zone disposed downstream of the condenser before the air can return through the radiator into the drum.

The inventor has previously proposed to carry out a spraying process upstream of the condenser. In accord-

ance with this proposal, the spraying nozzle was disposed between the blower and the condenser in order to obtain a certain preliminary condensation and thus a reduced condensation period. It was, however, found that the desired results were unobtainable in practice for the reason that the sprayed fine mist of the condenser settled on the surfaces of the condenser and thus formed an insulating layer which prevented adequate condensation of the solvent vapor flowing through the condenser. These observations show that a combination of spraying-nozzle cooling and closed cooling is neither very suitable nor advantageous.

It was more surprising to find that the combination provided in accordance with the invention was effective to reduce the condensation period substantially, and, at the same time, afforded the advantage that excessive drying of the goods in the cleaning drum was avoided. It has been proved in practice that the advantages hereinbefore described are actually obtained.

The effect of the method according to the invention resides in the fact that re-evaporation of the solvent occurring in the conventional condensers is suppressed, for it has been found that those quantities of the condensate which are just about condensed when the air passes through, re-evaporate and are carried into the circulating air streams. This particular portion of the solvent had therefore to be re-condensed.

A further effect of the method according to the invention is that a recondensation instead of the suppressed re-evaporation takes place, since the uncondensed solvent vapours leaving the condenser are precipitated. With the single passage of a gas stream, the condensation effect obtained exceeds substantially that obtained in the known dry-cleaning machines.

The air leaving the condenser is, however, at the same time enriched with fine droplets of the mist which are returned to the drum. In this manner excessive drying of the goods is avoided by virtue of the fact that the moisture present in the drying air is compatible with the percentage of moisture present in the goods.

In accordance with the invention, it is possible to vary the percentage of moisture present in the air stream by temporary operation of the spraying unit according to the invention. In this way, it is possible to conform to the nature of each individual article and to create various conditions, under which the goods in the drum are dried.

In one advantageous modification of the method according to the invention, the spray of liquid is directed against a baffle, over which the impinging medium together with the particles of solvent added thereto may flow down. By this means, the air escaping from the condenser is forced to pass through the spray in each case, and it is ensured that the residual solvent vapours are delivered for condensation. At the same time, a sufficient supply of moisture for enrichment of the air with water is available on the baffle. It may be found to be advantageous to feed a vapour condensate to the spraying nozzle, and thus to manage with a limited supply of water in the dry-cleaning machine, so that the costs of the operating medium used in carrying out the dry-cleaning operation are reduced.

One advantageous apparatus for carrying out the method according to the invention is based on a device for the condensation of the gases withdrawn from the cleaning drum of a dry-cleaning machine. The essential feature of the apparatus according to the invention is that at least one spraying nozzle for a liquid is provided in the zone between an ordinary condenser and the air shaft leading to the drum. The orifice of the spraying nozzle may preferably be directed towards a vertical wall, which may, for example, form the end wall of the housing which contains the condenser. In

accordance with the invention, the spraying nozzle may also be directed directly against the position at which the air leaves the condenser, thus avoiding from the start an escape of the gases together with portions of the solvent.

In this respect it has, in accordance with the invention, been found to be advantageous to provide the condenser in a downwardly sloping position in the direction of the radiator, so that the gases flowing through apply a vertical component force to the condensed drops of liquid. A condenser of this kind is not known. It may advantageously also be used in dry-cleaning machines without spraying nozzles.

The effect of condensers of this kind resides in the fact that the air stream produced assists in causing the condensate being formed to flow off, since the air stream, as it were, forces the condensate to flow off the laminated walls. It will be understood that this is based on the assumption that the air flows through the condenser in the direction of its inclination, so that a vertical component force of the flow is generated which causes the condensate to flow off more quickly.

In accordance with the invention furthermore, there is connected to the condenser a collecting trough from which the baffle on which the sprayed liquid impinges, rises. As a result of the combination of the said trough with the baffle and the sprayed liquid, re-evaporation of the condensate is avoided. Instead, a current is produced by which the condensate is forced to flow off without being capable of re-condensation even though it is still in contact with the air.

In accordance with the invention furthermore, a gap between the baffle and the radiator may be provided so that heat transfer is largely avoided. This means also serves to prevent re-evaporation of the solvent. The baffle may preferably be constructed as a deflecting wall for deflection of the air stream escaping from the condenser, the wall being either directly wetted with the liquid, or a haze formed of a fine spray of liquid may be disposed upstream of the wall. It may also be of advantage for the deflecting wall to be formed of a fabric of textile threads or wire which is moistened at least temporarily. The air passing to the drum may be passed through this fabric. If the fabric is wetted with liquid, fine droplets of mist will follow the air stream and thus prevent excessive drying of the goods.

This feature and further features of the invention are diagrammatically illustrated by way of example in the drawings, in which

FIGURE 1 is a diagrammatic view of a dry-cleaning machine, and

FIGURES 2 to 4 are partial views of various embodiments of the condenser arrangement.

FIGURE 1 shows a diagram of the fundamental parts of a dry-cleaning machine 1, in which the air present in the cleaning drum 2 and enriched with vapours of solvent and water is fed by a blower 4, driven by a motor 5, through a shaft 3 and a feed pipe 6 into a condenser 7. The solvent vapours are completely condensed in the condenser 7, whereas the air is returned to the drum 2 through a radiator 8 and a feed shaft 12.

In order to obtain intensive condensation of the gases and vapours in the zone of the condenser 7, a spraying-nozzle unit 10 is provided in the zone 9 between the condenser 7 and the radiator 8. A liquid, generally water, is introduced by the nozzle 10 into the air stream which is just leaving the condenser 7. Thus, re-evaporation of the condensate is safely avoided, and, moreover, additional condensation work is performed. In the embodiment illustrated in FIGURE 1, the flow issuing from the spraying nozzle is directed against the discharge end 11 at the rear of the condenser 7. In accordance with the invention, the condenser 7 is preferably provided with internal laminar walls between which the air flows over the whole width of the con-

denser 7. The liquid sprayed by the spraying nozzles, to which liquid the condensate of the solvent has been added, passes into a trough-shaped cavity 19 and thence into a drain 18 which leads to the water-separating tank.

In the construction illustrated in FIGURE 2, the spraying-nozzle unit 10 is provided at a much higher level and acts in the direction of a baffle 13 on which the air leaving the condenser 7 has to impinge in order to reach the radiator 8. During its return flow, the air, and the solvent vapours present therein cannot but pass through the spray of the spraying unit 10. The solvent vapours are pressed by the droplets of the spray against the baffle 13 which is provided at an angle or in a vertical position so that the solvents condensed thereon and the sprayed liquid have to flow downwards into the drain 18. On the other hand, the air flowing through the spray is enriched with finely dispersed drops of water which are thus carried into the drum 2 and prevent excessive drying of the goods. The spraying unit thus, as it were, causes the air to be introduced into the drum 2 to be re-condensed and moistened.

The construction shown in FIGURE 3 is based on a spraying-nozzle unit 10 which produces a mist 15 formed of a fine spray of liquid upstream of the baffle 13, through which mist the drying air has to pass before it can reach the radiator 8.

It has been found to be advantageous in all cases for the baffle 13 to be provided at a distance from the radiator 8, so that a gap 14, sufficient to prevent a transfer of heat from the radiator 8 to the baffle 13, is formed between the two parts. Re-evaporation of the condensed liquids on the baffle 13 is thus avoided.

Finally, in the embodiment illustrated in FIGURE 4, a fabric 16 which may, for example, consist of closely woven textile threads or wires, and which is, at least temporarily moistened by the spraying unit 10, is provided. In this manner, the recondensation obtained in the preceding embodiments is obtained, and, in addition, the fine fabric serves for the storage of water in the form of extremely fine droplets, so that the air passing through may be enriched with such droplets.

As before, the solvent is condensed on the baffle 13 and caused to flow-off downwardly thereon.

The invention permits the spraying-nozzle unit 10 to be rendered operative at any desired time. Thus, the spraying-nozzle unit 10 may, for example, be rendered inoperative during the initial period of the condensation time, since it is known that during this period a maximum amount of solvent is condensed within a very short time, for the reason that the condenser 7 as such carries out a sufficient amount of the condensation work. It is, however, known that the complete condensation of the residual solvent consumes substantially more time. During this period, the spraying-nozzle unit 10 may be started in addition to the condensation proceeding in the condenser 7, so that the total condensation time may be considerably reduced. The spraying-nozzle unit 10 may also be coupled with a hygrometer, by which the unit 10 is automatically started when the moisture conditions in the cleaning drum 2 have dropped below a determined value. It will be understood that there are many possibilities of obtaining various effects with the spraying-nozzle unit 10.

It has been found to be essential that the condenser 7 should be provided at an angle, so that its bottom surface 17 slopes from the blower 4 in the direction of the radiator 8. The air approaching from the drum 2 is then passed through the condenser 7 in a direction substantially parallel to the said bottom surface 17. The air stream thus also flows in a downwardly sloping direction. This measure is taken in order to ensure that the liquids condensed on the surfaces of the condenser are forced to flow rapidly downwards by the vertical component force of flow of the air, so that, by this means also, re-evaporation of the condensate is avoided. If the air were to be passed horizontally through the condensers 7, its effect on

the condensate which is about to flow down would be merely that of a frictional and braking action. The more steeply or the more obliquely the air is passed through the condenser 7, the more rapidly will the condensates flow-off from the walls. It will be readily understood that this measure may be taken not only in combination with the spraying nozzle unit 10, but that in dry-cleaning machines without a spraying-nozzle device 10, the condensers 7 may be provided in a position suitable to ensure that this measure alone assists in impeding or preventing re-  
evaporation of the condensate.

I claim:

1. A method of condensing the solvent vapours and gases from a dry-cleaning machine comprising the steps of passing the air laden with solvent from the cleaning drum under pressure through a closed condenser assembly to condense the solvent; spraying the air with a finely divided liquid mist subsequent to its exiting from said closed condenser assembly to completely condense the solvent, and to humidify or enrich the air with droplets of the finely divided liquid mist prior to its return to the drum; causing the solvent and the liquid to be directed to a tank for collection; and recirculating the humidified air to said drum.

2. A method according to claim 1, in which the liquid sprayed is caused to impinge on a baffle.

3. A method according to claim 1, in which the condensed steam is used for feeding the spraying nozzle.

4. A dry cleaning machine comprising, in combination, a cleaning drum, a blower for drawing the solvent-laden air from the drum, a closed condenser assembly through which the solvent-laden air is passed from said drum for substantially completing condensing the solvent; spraying means positioned downstream relative to said closed condenser assembly for projecting a finely divided liquid mist on to the air as it exits from said assembly, enabling the solvent to be completely condensed, and further enabling the air to be enriched or humidified with the liquid mist; means for collecting the completely condensed solvent; and means for passing the moisture enriched air to said cleaning drum.

5. A dry cleaning machine according to claim 4, in which the spraying means comprises one or more nozzles

and the liquid is projected to a zone between the condenser and a feed shaft to the cleaning drum.

6. Apparatus according to claim 4, in which the jet sprayed is directed against a substantially vertical wall.

7. Apparatus according to claim 4, in which the condenser is disposed at an angle downwardly towards the position of spraying.

8. Apparatus according to claim 4, comprising a radiator disposed between the condenser and a feed shaft of the cleaning drum, and wherein said spraying means is disposed between said condenser and said radiator.

9. Apparatus according to claim 4, in which, below the spraying position, there is provided a collecting trough having a baffle on which the spraying liquid impinges.

10. Apparatus according to claim 4, including a baffle and a radiator disposed at a distance apart so as substantially to prevent transfer of heat.

11. Apparatus according to claim 4, in which the baffle is provided in the form of a deflecting wall for the air stream issuing from the condenser.

12. Apparatus according to claim 4, in which the baffle is provided in the form of a deflecting wall for the air stream issuing from the condenser and in which the deflecting wall is formed of a fabric made of textile thread or wire which is at least temporarily moistened.

#### References Cited by the Examiner

##### UNITED STATES PATENTS

30	1,837,798	12/1931	Shipleigh	34-77
	2,453,859	11/1948	Pugh	34-75
	2,720,037	10/1955	Erickson	34-75
	2,722,057	11/1955	Pugh	34-75
	2,792,640	5/1957	Patterson	34-75
35	3,029,525	4/1962	Pinder	34-75
	3,132,005	5/1964	McMillan	34-75

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