Oct. 26, 1965 C. E. BEHRENS 3,214,026

SOLVENT RECOVERY DEVICE

Filed Oct. 3, 1961

Fig. 2

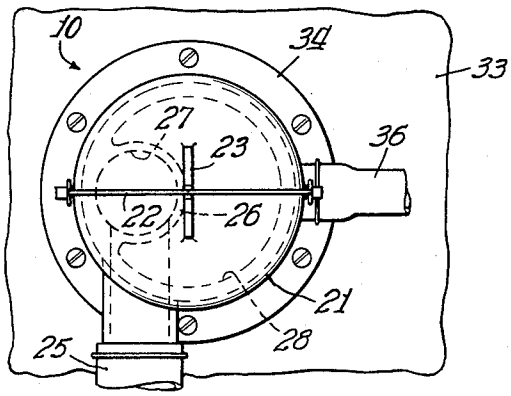
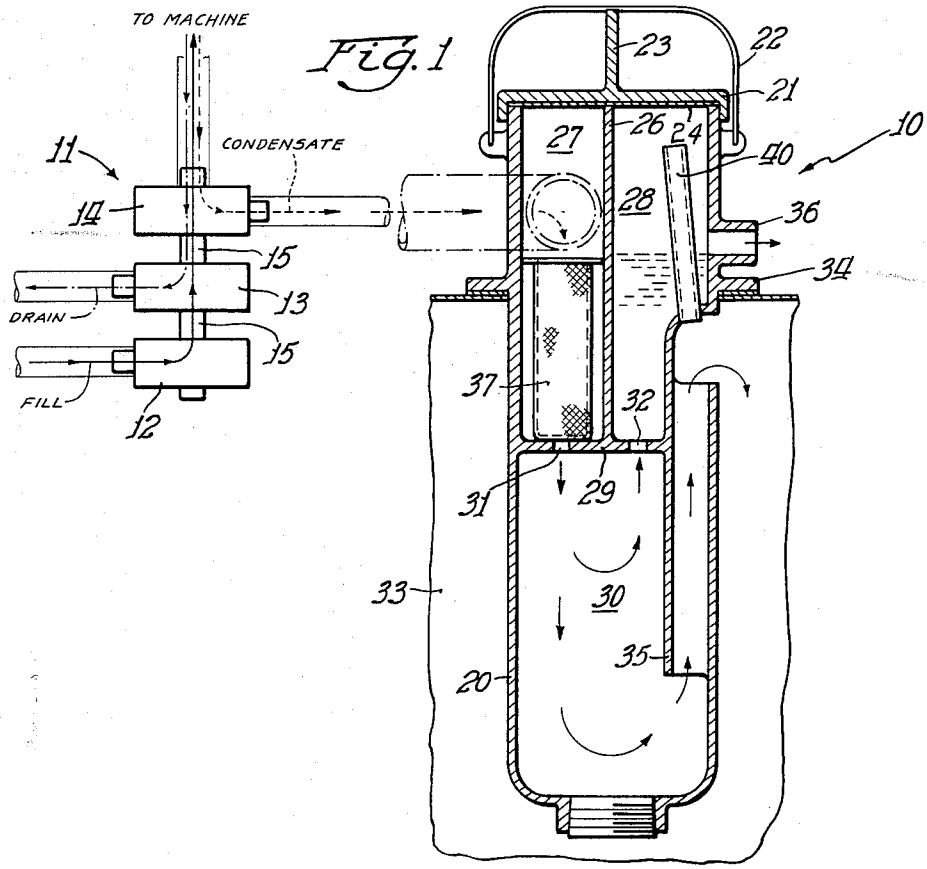


Fig. 1



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SOLVENT RECOVERY DEVICE

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This invention relates to a solvent recovery device and more particularly to such a device for separating solvent from a solvent-water mixture during a dry cleaning operation.

An object of the invention is to provide a new and improved solvent recovery device adapted to receive a solvent-water mixture from a dry cleaning machine operation, to stratify the solvent and water for flow of the solvent into a storage container, and flow of the water to a drain.

Another object of the invention is to provide a new and improved solvent recovery device for reclaiming solvent from a solvent-water mixture and having means for controlling the flow of the solvent, entering the device, to prevent interfering with the solvent and water stratification and separation function of the device.

Another object of the invention is to provide a new and improved solvent recovery device for reclaiming solvent from a solvent-water mixture and having a chamber for stratifying and separating the solvent and water and in which a baffle is provided at the solvent-water interface to define a solvent chamber and a water chamber, the device being further characterized by the baffle also having an orifice restricting and preventing an excessive quantity of solvent under pressure, accidentally entering the device, disturbing or mixing with the water in the water chamber of the device, the device functioning to permit the sweep of the solvent into and through the solvent chamber and from the device without contamination of the solvent with the water in the device.

Other objects and advantages will become apparent from the following description taken in connection with the accompanying drawings in which:

FIG. 1 is a longitudinal sectional view of the device and illustrating schematically a valve assembly of a dry cleaning machine connected to the device;

FIG. 2 is a top plan view of the solvent recovery device.

The solvent recovery device is generally indicated at **10** and may be used with a dry cleaning machine having a valve assembly generally indicated at **11** and including a valve **12** adapted to receive and control the flow of solvent, having a specific gravity greater than water and immiscible with water, into a dry cleaning machine, a valve **13** adapted to drain the solvent from the dry cleaning machine, and a valve **14** operative during a drying operation to control the flow of solvent and water condensate to the water separator device. The valves have a common flow passage **15** as shown with the valves controlling flow through the passage. More particularly, when the valve **12** is open and valves **13** and **14** are closed, solvent will flow through valve **12** and passage **15** into the machine for a fabric-cleaning operation. When valves **12** and **14** are closed and valve **13** is open, solvent will be drained through passage **15** and valve **13** from the machine. When valves **12** and **13** are closed and valve **14** is open during a fabric-drying operation of the machine, solvent and water condensate will flow through the passage **15** and valve **14** to the solvent recovery device. A more complete disclosure of the structure and operation of the valve assembly is provided in my U.S. copending application Serial No. 142,835, filed October 4, 1961, and now Patent No. 3,103,112.

Referring now particularly to my new and improved

solvent recovery device **10**, the device comprises a hollow tubular body or container **20** having its open top closed by a cover **21** clamped to the top by a pivotal bail **22** engaging a central riser **23** on the cover to insure a leakproof seal by a gasket **24** interposed between the top and the cover. The upper portion of the body **20** is connected to an inlet conduit **25** receiving solvent-water mixture flowing through the valve assembly passage **15** and open valve **14** into the body **10**. As seen in FIG. 1, the interior of the body **10** has a vertical transverse partition **26** in its upper portion providing chambers **27** and **28**, a horizontal partition or baffle plate **29** defining the top of a chamber **30** in the lower portion of the body and the bottom of the chambers **27** and **28** and separating the chambers **27** and **28** from the chamber **30**. As seen in FIGS. 1 and 2, the chamber **30** has a fluid capacity substantially larger than either of the chambers **27** and **28**. The chambers **27** and **28** are in fluid communication with the chamber **30** by the provision of balanced small orifices **31** and **32** in the baffle plate **29**.

The solvent recovery device **10** extends within and is supported on a solvent storage tank **33** and, for this purpose, is provided with an annular flange **34** seated on the opening-defining peripheral edge of the top cover of the tank. As seen in FIG. 1, the chamber **30** is provided with a tubular portion **35** for flow of solvent into the lower opening of the tubular portion for discharge from the upper opening of the tubular portion into the solvent storage tank. Also, the body **20** is provided with a conduit **36** for receiving water from the chamber **28** for flow to a drain.

In the operation of the solvent recovery device, the solvent-water condensate mixture enters at a very low flow rate into the conduit **25** and into the chamber **27** and through a tubular screen basket **37**, located in the chamber **27**, for filtering soil and lint particles from the mixture. The mixture then flows through the orifice **31** in the baffle plate **29** into the chamber **30**. The chamber **30** is effective to separate and stratify the solvent and water and operates on the principle that the heavier solvent will sink to the bottom of the chamber **30** and pass through the tubular portion **35** into the tank for recirculation to the dry cleaning machine while the lighter water will accumulate in the chamber **28** above the solvent in the chamber **30**, the water flowing through the small orifice **32** in the baffle plate **29** into the chamber **28** and through the conduit **36** to a drain.

A feature of the solvent recovery device is that the baffle plate **29** divides the body **20** into two chambers **28** and **30**, so that the stratified solvent and water is separated with the chamber **28** containing substantially only water and the chamber **30** containing substantially only solvent. This is accomplished by the baffle plate being located at the solvent-water interface of the two chambers and by the location of the solvent discharge outlet in relation to the interface. In experimental practice, the transverse baffle **29** is located by observing the solvent-water interface in a transparent model of the solvent recovery device.

A further advantageous feature is provided by the solvent recovery device. In the event the condensate valve **14** should not be closed, due to mechanical failure, during draining of the solvent from the dry cleaning machine and the solvent should flow, for example, at a very fast flow rate, such as 10 gallons per minute, through the passage **15** into and through the valve **14** and conduit **15**. Under such circumstances, previously known solvent recovery devices would become flooded with the solvent, and the water in the devices would mingle with the solvent and be flushed into a storage tank for recirculation to the dry cleaning machine and, in addition, the expensive solvent would completely fill the device and

flow out of the conduit **36** into a waste drain. In the solvent recovery device of the present invention, the orifice **31** in the baffle plate **29** restricts and controls the flow of the solvent to a maximum of about 3 gallons per minute to prevent excessive quantities of the drained solvent entering the lower chamber **30** during this valve failure condition. Further, the location of the baffle plate **29** at the solvent-water interface is effective to insure that only solvent is contained in the chamber **30**, due to stratification of the solvent and water, and that the water enters and remains in the chamber **28**. This factor is important as any solvent flowing under a pressure equivalent to 10 gallons per minute flow into the chamber **27** will have its pressure substantially reduced by the orifice **31** to flow at 3 gallons per minute, and as the chamber **30** contains only solvent, the passage **35** is substantially larger than the orifice **31**, only the bottom half of the solvent in the chamber **30** will be swept out of the chamber and through the passage **35** into the solvent storage tank with substantially no solvent passing through the orifice **32** into the water chamber **28**. During this solvent flow, the water is not significantly disturbed and is retained in the chamber **28** and will not be swept out by the solvent flow in the chamber **30** and passage **35**, the small orifice **32** preventing any sweeping action by the flowing solvent due to the size of this orifice preventing fluid turbulence in the chamber **28** during turbulent solvent movement in the chamber **30**.

If desired, a vent pipe **40** in the chamber **28** may be provided to equalize vapor pressure from the separator to the base tank.

While the invention has been described in detail, it is obvious that changes will suggest themselves, in adapting the invention to other than the disclosed usage, and it is intended that all such changes are contemplated as fall within the scope of the following claims.

What is claimed is:

1. A device for recovering solvent from a substantially immiscible solvent-water mixture capable of stratification and the formation of an interface comprising a container having an enclosing side wall, a bottom wall, and a top wall; a partition extending transversely of said container and in spaced relation to said top and bottom walls for defining an upper chamber and a lower solvent-water stratification chamber in said container; a vertical partition extending between said top wall and said transverse partition and dividing said upper chamber into a solvent-water mixture-receiving first chamber and a water-receiving second chamber; an inlet for the mixture into said first chamber and disposed in said side wall, said transverse partition having an orifice for flow of the mixture at a predetermined rate from said first chamber into said lower chamber and also having an orifice for the entrance of water, stratified in said lower chamber, into said second chamber; an outlet for water in said side wall for flow of water from said second chamber and said container; vertical passage means for flow of solvent from said lower chamber and said container, said passage means extending downwardly into said lower chamber and having an inlet end opening into said lower chamber, said passage means also extending upwardly above said transverse partition and having its outlet end terminating in an opening in said sidewall and disposed in a plane beneath and spaced from said water outlet, said transverse partition and said water outlet and passage means being located and arranged in said container to dispose the transverse partition adjacent to the interface of the stratified water and solvent whereby the lower chamber contains substantially only solvent and the second chamber contains substantially only water; and a generally vertical vent tube within said second chamber having its upper end disposed above the water in said second chamber and the water outlet and having its lower end terminating and opening into the solvent outlet to equalize solvent vapor pressure.

2. A device for recovering solvent from a substantially immiscible solvent-water mixture capable of stratification and the formation of an interface comprising a container having an enclosing side wall, a bottom wall, and a top wall; a partition extending transversely of said container and in spaced relation to said top and bottom walls for defining an upper chamber and a lower solvent-water stratification chamber in said container; a vertical partition extending between said top wall and said transverse partition and dividing said upper chamber into a solvent-water mixture-receiving first chamber and a water-receiving second chamber; an inlet for the mixture into said first chamber and disposed in said side wall, said transverse partition having an orifice for flow of the mixture at a predetermined rate from said first chamber into said lower chamber and also having an orifice for the entrance of water, stratified in said lower chamber, into said second chamber; an outlet for water in said side wall for flow of water from said second chamber and said container; and vertical passage means for flow of solvent from said lower chamber and said container, said passage means extending downwardly into said lower chamber and having an inlet end opening into said lower chamber, said passage means also extending upwardly above said transverse partition and having its outlet end terminating in an opening in said side wall and disposed in a plane beneath and spaced from said water outlet, said transverse partition and said water outlet and passage means being located and arranged in said container to dispose the transverse partition adjacent to the interface of the stratified water and solvent whereby the lower chamber contains substantially only solvent and the second chamber contains substantially only water.

3. A device for recovering solvent from a substantially immiscible solvent-water mixture capable of stratification and the formation of an interface comprising a hollow closed container; a generally horizontal partition in said container and in spaced relation to the top and bottom of said container for defining an upper chamber and a lower solvent-water stratification chamber in said container; a generally vertical partition extending between the top of said container and said horizontal partition and dividing said upper chamber into a solvent-water mixture-receiving first chamber and a water-receiving second chamber; an inlet for the mixture into said first chamber, said horizontal partition having an orifice for flow of the mixture from said first chamber into said lower chamber and also having an orifice for the entrance of water, stratified in said lower chamber, into said second chamber; an outlet for flow of water from said second chamber and said container; and vertical passage means for flow of solvent from said lower chamber and said container and extending into said lower chamber and having its inlet opening into said lower chamber and its outlet opening terminating in the side of said container and disposed in a plane beneath and spaced from said water outlet, said horizontal partition being located and arranged in said container to dispose the horizontal partition adjacent to the interface of the stratified water and solvent whereby the lower chamber contains substantially only solvent and the second chamber contains substantially only water.

4. A device for recovering solvent from a substantially immiscible solvent-water mixture capable of stratification and the formation of an interface comprising a hollow closed container; a generally horizontal partition in said container for defining an upper chamber and a lower solvent-water stratification chamber in said container; a generally vertical partition extending from the top of said container to said horizontal partition and dividing said upper chamber into a solvent-water mixture-receiving first chamber and a water-receiving second chamber; an inlet in said container for flow of the mixture into said first chamber, said horizontal partition having a first orifice for flow of the mixture at a predetermined rate from said first chamber into said lower chamber and also hav-

ing a second orifice for the entrance of water, stratified in said lower chamber, into said second chamber; an outlet for water in said container for flow of water from said second chamber and said container; and vertical passage means for flow of solvent from said lower chamber and said container and extending into said lower chamber and having its inlet opening into said lower chamber and its outlet terminating in a plane beneath and spaced from said water outlet, said horizontal partition being located adjacent to the interface of the stratified water and solvent, and said first orifice being substantially smaller than said vertical passage means, and said second orifice having an effective cross-sectional fluid flow area smaller than the cross-sectional fluid flow area of said vertical passage means for substantially preventing fluid turbulence in said second chamber during turbulent fluid movement in said lower chamber.

5. A device for recovering solvent from a solvent-water mixture comprising a hollow closed container; a generally horizontal partition in said container for defining an upper chamber and a lower chamber in said container; a generally vertical partition extending between the top of said container and said horizontal partition and dividing said upper chamber into first and second chambers; an inlet in said container for flow of the mixture into said first chamber, said horizontal partition having a first orifice for flow of the mixture at a predetermined rate from said first chamber into said lower chamber and also having a second orifice for the entrance of water from said lower chamber into said second chamber; an outlet for water in said container above said horizontal partition for flow of water from said second chamber and said container; and vertical passage means for flow of solvent from said lower chamber and said container and extending into said lower chamber and having its outlet terminating in a plane beneath and spaced from said water outlet, and said first orifice being substantially smaller than said vertical passage means, and said second orifice having an effective cross-sectional fluid flow area smaller than the cross-sectional fluid flow area of said vertical passage means for substantially preventing fluid turbulence in said second chamber during turbulent fluid movement in said lower chamber.

6. A device for recovering solvent from a substntially immiscible solvent-water mixture capable of stratification and the formation of an interface comprising a hollow closed container; first means defining an upper chamber and a lower solvent-water stratification chamber in said container; second means for dividing said upper chamber to provide a solvent-water mixture-receiving first chamber, and a water-receiving second chamber; an inlet in said container for flow of the mixture into said first chamber, said first means having an orifice for flow of the mixture from said first chamber into said lower chamber and also having an orifice for the entrance of water, stratified in said lower chamber, into said second chamber; an outlet in said container for flow of water from said second chamber and said container; passage means for flow of solvent from said lower chamber and said container and having its outlet end disposed in a plane beneath said water outlet, the portion of said first means between said lower chamber and said second chamber being located and arranged in said container adjacent to the interface of stratified water and solvent; and a generally vertical vent tube within said second chamber having its upper end disposed above the water outlet and its lower end opening into the solvent outlet to equalize solvent vapor pressure.

7. A device for recovering solvent from a substantially immiscible solvent-water mixture capable of stratification and the formation of an interface comprising a hollow closed container; first means defining an upper chamber and a lower solvent-water stratification chamber in said container; second means for dividing said upper chamber to provide a solvent-water mixture-receiving first chamber and a water-receiving second chamber; an inlet in said container for flow of the mixture into said first chamber, said first means having a first orifice for flow of the mixture from said first chamber into said lower chamber and also having a second orifice for the entrance of water, stratified in said lower chamber, into said second chamber; an outlet in said container for flow of water from said second chamber and said container; and passage means for flow of solvent from said lower chamber and said container and having its outlet end disposed in a plane beneath said water outlet, the portion of said first means between said lower chamber and said second chamber being located and arranged in said container adjacent to the interface of stratified water and solvent, and said first orifice being substantially smaller than said passage means, and said second orifice having an effective cross-sectional fluid flow area smaller than the cross-sectional fluid flow area of said passage means for substantially preventing fluid turbulence in said second chamber during turbulent fluid movement in said lower chamber.

8. A device for recovering solvent from a solvent water mixture comprising a hollow closed container; first means defining an upper chamber and a lower solvent-water stratification chamber in said container; second means for dividing said upper chamber to provide a solvent-water mixture-receiving first chamber and a water-receiving second chamber; an inlet in said container for flow of the mixture into said first chamber, said first means having a first orifice for flow of the mixture from said first chamber into said lower chamber and also having a second orifice for the entrance of water, stratified in said lower chamber, into said second chamber; an outlet in said container for flow of water from said second chamber and said container; and passage means for flow of solvent from said lower chamber and said container, and said first orifice being substantially smaller than said passage means, and said second orifice having an effective cross-sectional fluid flow area smaller than the cross-sectional fluid flow area of said passage means for substantially preventing fluid turbulence in said second chamber during turbulent fluid movement in said lower chamber.

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