This invention relates in general to washers and dry cleaners, and more particularly to a new form of dry cleaning machine. The machine or machines herein described are susceptible to either manual, semi-automatic, or full-automatic control.

This application is a continuation in part of my earlier application filed in the United States Patent Office on October 14, 1935, Serial No. 44,823, entitled Dry cleaning unit.

My invention is new and useful, among other things, in its unitary and compact form of closed or sealed work-treating chamber, and is new in its solvent-washing and air-drying apparatus housed within said chamber, together with a sealed-solvent system comprising a new recovery and refining apparatus combined with said sealed chamber for reclaiming and clarifying all solvents and used solvent. This characteristic combination possesses a mode of operation which sets a new standard of usefulness and efficiency in dry cleaning machines.

The dry cleaner embodying this invention is adapted to use a non-inflammable volatile detergent or solvent washing liquid which dissolves and removes the grease and foreign matter from the clothing and other work being cleaned. Such a washing liquid rapidly volatilizes and leaves the work air dried by vaporization, as understood in the dry-cleaning art. There are a number of suitable solvents or volatile washing and dry-cleaning liquids on the market. A chlorinated hydro-carbon, carbon tetrachloride, perchloroethylene, or some analogous agent may be used in this machine. These dry-cleaning liquids are quite dense and somewhat heavier than water. The cost of such liquid solvent renders expedient its conservation for use over and over again. In the invention of dry cleaning, when this method of washing became known, a variety of petroleum-base and other volatile-washing liquids was and still is used at times as solvent agents, but such liquids are unsuited because of fire hazard and other objections. They are preferably not used in my machine.

It is an object of the present invention to produce a washing machine of the solvent or dry-cleaning type which is power driven and may be made fully automatic throughout its several operating cycles or steps, the primary ones in my machine being washing, rinsing, extracting, drying, deodorizing which is optional, vapor-solvent recovering, and liquid-solvent refining or clarifying, together with any number of intermediate or repeat operations in addition to this series of seven or eight principal cycles named as an example of one complete dry-cleaning run or operation. The control of my machine, when set for automatic operation, is completely removed from the operator from the time the machine starts a run until it has completed its operation. This removes all inaccuracies arising from manual control, and makes for uniformity in quality as well as increased production of work.

Conducting the cycle operations of this machine may involve some thirty to fifty, more or less, interdependent automatic manipulations of the various controls. This is effected by an automatic pilot or cycle timer by which the operating sequence of the machine is expedited and advanced step by step. My automatic dry cleaner can be so set and controlled that its operations are timed and follow each other in rapid succession, in accordance with any suitable program for washing or dry cleaning carried out by an automatic-cycle record. This record comprises a schedule selected and made by the attendant or operator of the machine as best suited to his local conditions and the general character of work at hand, and is sometimes called the "Formatrol" record which is the trade mark for the cycle timer of this machine.

My machine employs any suitable cycle timer, and so in the present description I only briefly refer to same in order that it be understood how my dry cleaner is adapted to automatic control. A cycle timer is preferably used for controlling the period of each operation of the motor means for effecting the several drive motions of the clothes receptacle or washing drum within the sealed work-treating chamber, and also for remotely controlling the opening and closing actions of the various valves in the solvent-flow piping, in the steam lines connected with the air-heating means and with the still, also the valves in the cold-water piping leading to the vapor-solvent recovery condenser and the cooler for the refined solvent as well as the still condenser, and also for controlling the air valves and blower fans in the vapor and air ducts forming the air-drying circuit within the sealed work-treating chamber. Taken all together, these automatic actions comprise the considerable number of operations herefore mentioned to carry out the step-by-step cycles of washing, extracting, drying, vapor-solvent reclaimation effected within the sealed chamber, and the liquid-solvent rectifying or clarifying operations performed by the automatic still and other solvent-handling apparatus included in my invention.
It is a further object of this invention to produce a new form of dry-cleaning machine having its component parts organized and grouped into a compact unit which occupies little space as compared to conventional dry-cleaning plants and machinery, and to provide a new combination and relation of the various receptacles and drying means sealed within the work-treating chamber to insure against loss of the valuable solvent agent.

More particularly, it is an object to produce a dry-cleaning machine, the washing and air-drying apparatus, as well as the related solvent-handling or treating apparatus, both of which are sealed from the outer atmosphere, and wherein all liquid and vapor solvent is extracted from the saturated work or clothes, as well as recovered from the air coming in contact therewith while drying said work, and thereafter this reclaimed solvent is automatically cleaned, purified, and cooled whereupon it is again accumulated in a solvent storage tank for further use. This simultaneous treating of the work, and treating of the solvent, takes place within my new combination sealed-washing chamber and sealed solvent-handling system.

In connection with the foregoing, it is an object to provide a novel water separating means which removes all water from the solvent immediately after the recovery of the vapor solvent or fumes from the washed and dried work, and to again remove any remaining traces of water after said recovered solvent is clarified by distillation. Consequently, the solvent is purified both before and after the distilling operation takes place, and this makes for efficiency in the solvent-refining cycle.

It is also an object to produce an automatic dryer cleaning having a washer means operable in a sealed work-treating chamber and operable in conjunction with the sealed solvent system aforesaid, but which nevertheless may be desired to have its sealed chamber temporarily vented or opened to atmosphere for deodorizing, aeration, or freshening of the work, after all the solvent has been recovered therefrom during the hot-air drying cycle. This object is attained by my new and positively operated block-off valve means which automatically and simultaneously seals off the solvent system from the externally vented dry-cleaning chamber when the latter is temporarily opened to atmosphere. Consequently, all solvent lines and vessels remain sealed from the outer atmosphere while the work is being freshened by deodorizing, i.e., blowing outside air through the washer means within the temporarily vented work-treating chamber. In this way, the solvent system itself is permanently sealed from contact with the outer atmosphere during all cycles of operation.

Likewise, it is an object to provide a new means and mode of deodorizing or freshening the work, as the final step in the dry-cleaning process, by arranging for further recovery through condensation, while the deodorizing cycle is in progress, in the event there remains any traces of solvent in the work after the hot-air drying cycle is completed and when the deodorizing cycle begins. This is in keeping with my principle of not allowing any solvent, whether liquid or vapor, to be lost to atmosphere; and my new arrangement of parts within the closed chamber acts to recover any remaining traces of solvent which ordinarily are carried off and lost during the deodorizing operation of present day dry-cleaning systems.

Another and one of the more important purposes of my invention is to produce a dry-cleaning machine having a sealed work-treating or washing and drying chamber of integrally walled construction which alone performs a number of functions and hence is new by virtue of its particular walled arrangement. Among these features it is noteworthy that my sealed chamber itself takes the place of conventional framework, not only to support accessory parts of the machine including the washer apparatus by carrying the main bearings for the primary moving parts but also to form the walls of the sealed chamber as well as certain closely arranged internal tank and sub-chamber walls. The sealed chamber also constitutes characteristically short-air and vapor-conducting passages for communicating the washing vat with a new vapor and air, heating, means, with a vapor-solvent recovery means, a water separator, a sump or dump tank, and air-filter means, all of which are self-formed and self-contained by and within the wailing structure of the sealed work-treating chamber in a manner which group the parts in a closely coupled arrangement. The comparatively short-vapor passages reduce skin friction of the vapor and air flow and economize in the consumption of power required to operate the machine, and more particularly economize in power required to circulate the air and vapor through the sealed work-treating chamber and its closely connected ducts.

The wailing arrangement of the foregoing paragraph attains a further object by rendering unnecessary the conventionally spaced solvent tanks and their exposed piping now largely employed in joining the several separated parts of dry-cleaning plants of the prior art in operative communication with each other. By this invention, I have made a new grouping arrangement of the previously scattered members of a conventional dry-cleaning plant so as to reduce the number of pipe connections, and thus eliminate gaskets and pipe fittings, and also to correct other conditions which have been conducive to leaks and solvent waste in both vapor and liquid form. There results a marked economy in the use of solvent, a reduction in the number of parts and joints in this new combination, and an enhanced appearance.

Another one of the more important objects of my invention is to provide a novel intervening or internal pressure-equalizing means which is sealed from the atmosphere, and by which all liquid-solvent and vapor-solvent circuits inherently maintain a stable and internally self-balanced condition safely operating at about atmospheric pressure. This internal breathing, or what may be called the intervening feature, promotes an easy gravity flow or transfer of the refined solvent from the automatic still condenser to a solvent storage tank and thence into the washing chamber, and air into the re-refining of the dirty solvent from said washing chamber back to the reining still and clarifying apparatus.

A further object and an important mode of operation attained by this invention is the provision of a closed solvent system as one part, which operates in conjunction with a closed work-treating chamber as another part, wherein each part or assembly functions as an intervening breather or pressure-equalizer means for the other. Such a combination inherently maintains a normally-stable internal-working pressure at about that of atmosphere as before...
stated. Consequently, there are no factors or conditions in my new combination which cause undue fluctuations of pressure. My dry cleaner, therefore, is free of undue negative or positive internal pressure fluctuations. The air or gas which is pumped outward to atmosphere. Such open or vented conventional dry-cleaning plants or machinery of the prior art operate with a considerable loss of solvent by reason of discharging vapor solvent to the atmosphere. The present invention, however, corrects this faulty condition and it is now entirely feasible to use the somewhat expensive solvents in an economical way.

In my invention, it is one of the outstanding purposes to so organize and proportion the sealed apparatus as a whole that the quantity of clarified solvent, which is refined by the still and its condenser, rapidly flows therefrom by gravity into a storage tank and simultaneously displaces or transfers the air from the latter through the intervening lines into some other closed vessel of internal pressure. This results in two advantages. This avoids any tendency for the still to build up pressure in the closed solvent system and its closely coupled washing chamber. To the same effect, the vapor or fume recovery condenser, within the sealed dry-cleaning chamber, is made ample in capacity by the internal pressure and this as rapidly as the solvent is released by vaporization and driven or withdrawn from the saturated work by the forced circulation of warm air passing over and through said work. This characteristic of my construction avoids all tendency of an internal pressure build-up within the sealed work-treating chamber and its closely coupled solvent system. The sealed apparatus as a whole, therefore, is self-equalizing as to its internal-pressure conditions, attaining this new mode of operation by its enclosed interbreathing or ventilating system.

In the foregoing provisions inherently maintaining a stable internal-working pressure at about that of atmosphere, it is an object to provide a safety interlock between the steam pipe and cold-water pipe lines respectively, with the still and its condenser. The purpose of this interlock control is to automatically stop the steam-heating function of the still and thus its vaporizing action, in the unlikely event of the cold-water supply to the still condenser being interrupted and thus the cessation of its condensing action. Consequently, there can be no over-run or excess vapor production from the solvent-refining still to create an internal-vapor pressure unduly above that of atmosphere within the sealed system. This is accomplished by providing means for automatically closing a valve in the steam-supply pipe leading to the still in the event the cold-water flow should for any reason stop running through the still condenser.

It is a further object to provide a vapor-solvent condenser means comprising a reclaiming or recovery condenser within the sealed work-treating chamber, in combination with a still condenser, the joint operation of which provides for maximum efficiency. To this end, I employ a fixed or constant flow of cold water through the cooling coils of not only the recovery condenser but of the still condenser as well, which is to say that the rate of cold-water flow, as required to attain maximum efficiency for a given set of local conditions, is first determined or approximated, whereupon that ascent of condenser cold-water flow is then fixed, so as to remain a constant factor in the machine operation selected for said given conditions. Such an arrangement, therefore, makes it a simple matter to insure against a possible internal-vapor pressure build-up, and this is insured against by maintaining the source of vapor production which is the still.

For this purpose, the still and its condenser have been interlocked, as aforesaid, so that they are off and on together, one being incapable of functioning without the other.

Finally, there is provided a normally-closed safety or relief valve in communication with the sealed work-treating chamber and the sealed-soil system to take care of any possible failure of the safety-control interlock between the still and its condenser. This may be a simple form of relief valve which momentarily opens to atmosphere under the influence of an internal-vapor pressure rise, just above that of atmospheric pressure, say at about a three pound pressure, more or less. This safety valve will be open readily and relieves any excess pressure, inherently provided against as heretofore mentioned, in the unlikely event that the safety interlock should fail; which is to say that wear or other conditions, beyond one's control, might eventually lead to a leaky steam valve which, in time or by long use, might not fully cut off the flow of steam to the refining still in the event of failure or the stoppage of flow of the interlocked supply of cold water running through the still condenser. Save for this normally-closed safety valve, which is common to both the sealed chamber and solvent system, my new dry-cleaner apparatus as a whole has no vent to atmosphere which would permit solvent to be lost. This safety or relief valve rarely if ever has been known to open.

It is a further object to produce an automatic dry cleaner in which a single housing or cabinet is so fashioned that it is not only pleasing in appearance but provides the sealed work-treating chamber containing its vapor-solvent recovery means hereetofore mentioned, as well as providing a rear compartment containing the motor or motors for driving the washer means within said chamber. This rear compartment also contains certain of the automatic-controlling apparatus which govern the cycle action of the machine throughout its numerous individual step operations carried out in cleansing a load of soiled work and reconditioning the recovered solvent for the next batch-washing operation.

My dry cleaner, therefore, in addition to its symmetry of design, is not so heavy, occupies less floor space, is externally clean, and can be esthetically fashioned by modern appearance, as shown in my design patents, Des. 100,546 and Des. 100,547. Such a machine has the advantage of being well suited for use in stores and the like where heavy-plant machinery, styled after the prior art, is unsightly and entirely out of place.

The views in the drawings

The accompanying drawings illustrate an example of the invention in both schematic and structural form, and it is to be understood that various changes in arrangement, shape and re-
relationship, and the enclosing and sealing of parts, may be made without departing from the teachings herein. The drawings are arranged to portray the principles of the invention, and certain views show the related compactness and unified construction of the machine in one of its preferred commercial forms as now manufactured.

Figure 1 shows a front right-side perspective view of the machine in one of its commercial forms. The forward portion of the machine cabinet comprises the sealed work-treating chamber in which the work is washed and dried. The rear portion of the cabinet comprises an open motor compartment for housing the motor means and the automatic controls. The cycle timer with its automatic record and its optional manual-control buttons for controlling the machine is to be seen mounted on the left side and near the front end of the cabinet. The still with its condenser thereabove, comprising part of the solvent-treating system, is located outside of the cabinet to the left and rear thereof.

Figures 2 and 3 are details of one commercial form, and show sectional details of the front portion of the machine cabinet, i.e., the sealed washing and drying (work-treating) chamber per se. My new dump valve, in combination with its pneumatic-operating means and button trap, is shown in elevation carried on the left side of said chamber. Figure 2 shows the left side of the chamber in elevation, although the upper part is sectioned along the line 2—2 of Figure 3, with a fragment of the motor compartment portion of said machine cabinet at the left, i.e., in the rear of the sealed chamber; and a solvent storage tank is mounted within the upper part of said motor compartment. Figure 3 is a front vertical section taken on the line 3—3 of Figure 2.

Figure 4 shows the solvent and vapor flow circuits with pressure-intervening lines. This is the liquid solvent piping and vessels with the intervening or interbreather lines sealed from atmosphere, constituting the combined liquid and vapor-solvent system; and the sealed work-treating chamber is connected in series therewith. The heavy lines and the heavy single-headed arrows in this view show the liquid-solvent flow pipes and vessels. The light lines and the light double-headed arrows show the solvent vapor circulating and pressure-equalizing intervent connections between the liquid-solvent pipes and vessels. The heavy dotted arrows represent water separation. This Figure 4 is also presented in a modified form, by showing the use of my dry cleaner without the deodorizing-valve means.

Figure 5 is a schematic view of all liquid and vapor flow circuits. This view of the general combination shows a development from Figure 4, and it is a diagram of the complete apparatus including a steam-supply pipe with its branch lines, a cold-water supply pipe with its branch lines, and an air-pressure supply pipe with its branch lines, all of which are in addition to the solvent and vapor flow circuit with pressure-intervening lines in the previous view. The light arrows show the flow of steam and vaporized solvent, the heavy arrows show the flow of liquid solvent and cooling water, and the heavy dotted arrows indicate water separation from liquid solvent taking place.

Figure 6 shows a front section through the sealed work-treating chamber taken on a vertical plane through the axis of the washer drum and looking toward the front of the machine. The air circulating fans and ducts, as well as the solvent pump, are spread out in schematic form to better illustrate this phase of the invention. The direction arrows show the flow of the air and vapor. At the upper part of this view the open mouth of the machine, or the top section, is shown in one of the air filters. The arrow shows a solvent drain from the main bearing or bearings of the washing-drum shaft forming a solvent return back to the interior of the sealed chamber.

Figure 7 is a perspective view of one of the vapor filters or screens detached from its retaining plate or frame in the sealed work-treating chamber. This view shows the principle of the vapor filters and one form of bag-like construction thereof. Six of these air filters are shown in the other views as an example of my invention, although the size and number of filters may vary somewhat so long as an adequate filtering area is provided in the air and vapor duct within the rear of the sealed chamber.

Figures 8 and 9 show horizontal cross sections through the lower portion of the sealed work-treating chamber to illustrate the fume or vapor-recovery condenser chamber located between two air-heater chambers.

Figure 8 is made on the line 8—8 of Figures 10 and 11, and the arrows on the pipes show the direction of the cold water flowing through the pipe coils in the solvent-recovery condenser chamber and the two air-heater chambers, respectively.

Figure 9 is a view taken on the line 9—9 of Figure 11. The direction arrows in the chambers, crossing the pipe coils, indicate the steam and air flow. Figure 9 is to be read with Figures 10 and 11.

Figures 10 and 11 are read together and in conjunction with Figure 9. These three views, with direction arrows in the flow passages, show the hot air drying circuit within the sealed work-treating chamber by which the solvent is vaporized and driven by heated air from the clothes to dry them in the washing drum, and to recover the solvent therefrom in the form of vapor which is liquefied by a recovery condenser. Figures 10 and 11, are vertical sections, respectively, on the lines 10 and 11 of each other.

Figures 12 and 13 are also read together, and show the fresh air deodorizing circuit for defum ing and freshening the air-dried work. During this process the several liquid-solvent pipes and vessels draw off fresh air in near the bottom of the machine and discharges it at the top left side as shown by the spray of direction arrows at those two locations, but the solvent system is not vented. While deodorizing, the fume or vapor-recovery condenser chamber is shut or blocked-off so that the solvent-handling or treating system as a whole remains positively sealed from atmosphere. The fresh cool air, therefore, cannot blow through the recovery condenser or otherwise circulate with the solvent system. The steam circulation through the two air-heater coils is also assumed to be discontinued so the air is not heated during this fresh-air finishing cycle. These Figures 12 and 13 are developed on the vertical section lines 12 and 13, respectively.

In the foregoing Figures 6, 8, 9, 11 and 13, it is noted that some of the vapor-flow direction arrows are dotted, or that they are partially dotted. Such method of illustration is resorted to in showing the air and vapor flow behind the various walls in the compartmented washing and drying chamber.
My related copending drive case

One branch of invention, as embodied in this automatic dry cleaner as a whole, relates to the motor means or power drive for imparting to the washing drum herein the several required motions during a complete dry-cleaning operation or run with the work. One type of automatic-motor means or power drive, well adapted for use in combination with and for driving and controlling the dry cleaner herein, is represented by my companion invention which is independently disclosed and claimed in my copending application entitled the automatic drive and washer hereinafter filed in the United States Patent Office on October 12, 1935 under Serial Number 44,653, now Patent 2,086,633, issued October 6, 1936.

Said copending application 44,653 more particularly claims the new combination in a washer generally, with an automatic-motor means and a cycle control therefor comprising one divisible branch; or what I sometimes call my “drive case”.

The instant case, however, claims my sealed work-treating chamber with its automatically-controlled hot and cold air-blowing circuits, and thus comprises another divisible branch; or what I sometimes call my “cabinet” or “machine case”.

For clarity, in introducing the description of the present invention, the same reference characters will now be used, as were employed in said previously-filed copending application 44,653, insofar as said part numbers are in common in the two cases. In addition thereto, I will first describe such parts and features of the instant invention as are also shown in the previous case. The ensuing description, therefore, is made sufficiently complete as to render unnecessary a study of said copending application for an understanding of the claimed subject matter herein.

The work-treating chamber and the drive means in general

Referring now to the drawings appended hereto, the sealed washing and drying chamber at the front of the machine cabinet is herein designated 1, and the motor compartment at the rear is designated 2, and the motor compartment 1 may be formed of the same side plates or wall structure as that of the sealed chamber 2, but these two cabinets central portion 3 is usually constructed in separate assemblies, then the two are placed in juxtaposition and bolted or otherwise anchored together to form a single cabinet 1, 2 of well proportioned and pleasing appearance, as shown in Figure 1. A fragmentary part of the separate motor compartment 2 is also to be seen in other views, but it is not of direct importance here.

Although the sealed work-treating chamber 2 may be constructed of any suitable material and manufactured by any appropriate method, a description will now be given of this chamber produced in a way found practical and satisfactory in its commercial use.

The sealed dry-cleaning or work-treating chamber is in part formed by the two vertically spaced side walls 4 and 5 by a top wall 6 integral with the sides 2. In effect, the wall 140 forms the front wall of the motor compartment 1. A bottom wall 2a and a top wall 2b integrally join the rear wall 140 and the two side walls 2. A front cabinet wall comprises a central upper portion 8 in the form of a sector arched forwardly of a vertical and flat lower wall 5a. A front upper wall 5f slants rearwardly and joins the top wall 2b and also joins the arched central wall 5 to complete the sealed work-treating chamber designated as a whole at 2. For convenient reference, the sealed work chamber 2 is generally of rectangular form.

The six principal walls or enclosing walls have their meeting edges integrally joined as by welding into one unitary chambered structure 2 rectangular in cross section. This produces a fully-closed chamber within which the work, the air drying, and the vapor-solvent recovery or reclaiming operations are carried out; and by temporarily opening this chamber 2 to atmosphere, with a simultaneous blocking-off of the solvent system, the deodorizing cycle, if used, is effected in the chamber in a new and improved way.

This six-sided walling structure forming the chamber 2 is fabricated from sheet stock, say boiler plate. The side plates 2 in particular may be of somewhat heavier or thicker plate stock than the other walls so as to carry the bearings for the washing drum, also support other apparatus, and much particularly render framework unnecessary. Since this work-treating chamber 2 is a fabricated weld construction, I prefer to use a heavy plate stock which has one of the flat shape and avoids warping under the high temperature employed during the welding and the galvanized-plating processes employed in manufacturing the washing chamber 2. In order to eliminate galvanizing or internal plating of the sealed work-treating chamber 2, a nickel-clad or other resistant-surfaced plate stock may be used for integrally fabricating the chamber 2.

As one example of my manufacturing practice, I have made the vertical side walls 2 of plate stock or steel about three-eighths of an inch thick, and have made the other walls about three-sixteenths. The use of these gages of plate stock of rather substantial construction is a direct result of one preferred manufacturing practice based on economy as regards selection of materials and the practical welding and galvanized-plating requirements when the chamber 2 is constructed that way.

The closed chamber 2 is inherently further strengthened by reason of its internal walling and partitions, all of which are integrally manufactured. Hence, the work-treating chamber 2 is sufficiently strong to withstand internal pressure or vacuum conditions if they arise. That they do not arise is due to my characteristic design and mode of sealed operation, by which is attained an internal-working pressure normally about equal to that of atmosphere, as previously mentioned. This desirable condition is naturally conducive to solvent economy since it minimizes the tendency of vapor to escape from or air to enter into the sealed chamber 2, which is to say that there is no tendency for said chamber to breathe in and out during normal operation at about atmospheric pressure. A cylindrical washing vat or tub 6 is mounted horizontally within the sealed chamber 2 and has its ends integrally joined with the two spaced side plates or header plates 2. The lower side wall 2 closes one of the ends of the washing vat 6. The other side plate 2 is formed open in a circular cut-out, as shown at 68 in Figure 3. This circular-end opening 68 is closed by a removable circular cap or plate 6b bolted down by cap screws or otherwise anchored over said open end 68 of the vat 6, with a gasket therebetween to make
a liquid and vapor-tight fit, which completely seals said vat ends within the fabricated chamber 2.

A rotary clothes receptacle, in the form of a washing drum 7, sometimes called the washing wheel or cylinder, is peripherally perforated through its entire length as indicated as 11. It is conventional practice to radially partition it into about three work-receiving pockets and provide a slide door for each pocket as shown. The drum is fixed on and carried by a drive shaft 8 journalled in the bearing 9. The drum on washing cylinder 7 is oscillated, i.e., reversibly rotated at slow speed for washing, rinsing, and dry tumbling the work therein, but it is whirled at high speed in one direction to extract the solvent by centrifugal action after each washing and rinsing cycle. For extracting, the washing drum 7 preferably is whirled counterclockwise, or turns to the left, as observed in Figure 5.

A door 9 has its upper margin fixed by bracket means 12 to a horizontal rock shaft 10 on the front of the chamber 2. A handle 11 is provided for opening the door 9, and an operator 3 is so located on the outer side of the door 10 to positively lock the door 9 closed during the high-speed rotation of the washing drum 7 while extracting the solvent from the saturated work, although said locking device is adapted to permit the door to be opened during the slow-reverse (oscillating) movement of said drum when the latter is tumbling the work. A door-switch arm 14 is fixed on the other or left end of the shaft 10 and connect with an electrical switch within a switch box 15 and is adapted to automatically stop the machine in the event the operator should open the door 9 while the drum 7 is oscillating.

The motor means for driving the washing drum 8 is merely indicated by dotted lines (Figure 1) herein, since it is obvious that any suitable driving apparatus may be used. A motor shaft 20 projects through the side wall of the motor compartment 1 inside of which is housed an electric motor means not shown. A drive pulley 21 is fixed on the shaft 20. Likewise, a driven pulley 23 is fixed on the washing drum shaft 8. A belt 22 encircles the two pulleys and drives the drum shaft 8 from the change-speed reversible motor shaft 20. A belt cover 225 may well be provided to enclose the driving transmission referred to. The automatic operation of the motor shaft 20 and transmission 22 selectively runs at high speed at one time to whirl the drum 7 for extracting solvent from the work, and at reversing-slow speed at another time to oscillate or tumble the work.

It is also to be noted that automatic switches, within the boxes 24 and 33, and other cycle control apparatus, govern the action of the motor means not shown herein, which is adapted for operating the drive shaft 20. These automatic features are the subjects of a companion invention claimed in the earlier-filed "drive case" heretofore mentioned.

**Internal construction and accessory parts of the sealed work-treating chamber 2**

A horizontally disposed rectangular plate 141 has its four marginal edges welded into the four upright walls 2, 2, 5, and 140, forming the sealed cabinet work-treating chamber 2 in which the complete dry-cleaning operation is performed. This plate 141 is placed just above the bottom 2, and it makes a partition in the form of a cover for a sub-chamber or compartment called the gump tank DT. A cover for a sub-chamber or compartment called the gump tank DT. It is capable of receiving all the wash liquid or dirty solvent dumped and quickly drained by gravity into said tank from the washing vat 6. This plate 141 may be a little lower at one edge, say its rear edge (Figure 2), than at its front, and may also be pitched (Figure 3) toward its open end so as to drain rearwardly the solvent which condenses and collects on the upper central surface thereof during the operation of a vapor-solvent recovery condenser to be described.

A second horizontal partition 28 of flat and level form is welded into the sealed chamber 2 above the cover 141 of the dump tank DT. A pair of vertical partitions 27 (Figure 3) are set in between the two horizontally spaced partition plates 28 and 141. This arrangement provides two space close it, and up to the vertical plate 140. Two of the two vertical partitions 27 have their rear ends joined to the rear cabinet wall 140, while the front ends join an upright rectangular closure plate 28 constituting the front wall of the recovery condenser RC. This plate 28 has a large outlet port forming a block-off valve seat 29 which opens outwardly from the recovery condenser RC. This valve port 28 is adapted to be closed to block off the recovery-condenser chamber RC from other parts of the machine, thus sealing said chamber and its associated solvent system from communication with the outer atmosphere in the event the deodorizing cycle is employed, as later explained.

The spread of the upper horizontal plate 26 forms a top which completely covers the two air-heater boxes HB and substantially covers the centrally located fume or solvent-recovery condenser chamber RC. The plate 26 can be made in one or more sections, but for simplicity it is shown here in one piece and divides off the upper portion of the work chamber 2 from the lower part thereof, leaving only a rear opening 30 leading downwardly into the recovery condenser RC. This rectangular hole 30 opens between the two vertical partitions 27, as seen in plan in Figure 8. Said opening 30 is the lower terminus of a passage labeled "air and vapor duct" (Figure 4) at the rear of the vat 6. The opening 30, therefore, communicates the upper part of the sealed chamber 2 with the rear of the recovery condenser RC located in the lower part of the sealed chamber 2.

From the foregoing, it is to be seen that a flow of air and solvent vapor can pass downwardly along and inside the wall 140, through the rectangular opening 30, into the rear of the recovery condenser chamber RC, then through the discharge port 29 located at the front of said condenser, which port is midway between the two air-heater boxes HB open at their front ends. The plate 28 and front wall 9, 5 are vertically arranged and spaced apart, and consequently provide a lateral air passage 9, 5 leading from the central block-off valve port 28 to both heater
boxes HB. Thus, the vapor-free air blowing from said port 28 divides and blows laterally in both directions (Figure 9) into the front open ends of both heater boxes HB.

5 In some forms of construction, it is well to set in a vertical fume passage plate 31 to cut out the dead-air space not used under the washing vat 6 so as to reduce the skin friction of the air and vapor by eliminating eddy currents, and to better concentrate a straight and even down blow of said air and vapor to and through the opening 30 into the upper rear part of the recovery-condenser RC. This inside plate or wall 31 has its inner edge joined to the rear of the vat 6, with its bottom edge welded to the horizontal partition 28, and is shown (Figure 8) extending from side to side of the sealed work-treating chamber 2. The plate 31, spaced from the rear cabinet wall 146, in part forms the straight down “air and vapor duct” 31, 140 behind the vat 6 and through the rectangular opening 30 into the recovery-condenser chamber RC. It is now observed that this opening 30 is bounded by the two vertical partitions 27 and the rear cabinet wall 146.

10 Also it will be seen that there is provided in the rear of the large work-treating chamber 2 the vertical vapor duct 31, 140 down which a vapor solvent and air mixture flows to give up its solvent in the recovery chamber RC, as later shown; while at the front of the machine there is provided the lateral air duct 5, 26 through which the vapor-free air flows from the recovery-condenser RC to the two heater boxes HB.

15 A vapor filter frame 33 (Figures 2 and 3), with openings at 34, is set into the upper portion of the sealed work-treating chamber 2 and extends the length of the vat 6. It is shown in this example of the invention in a vertical position joining the top wall 22 and vat 6. Its lower edge is just to the rear of a series of slots or perforations 35 through the top of the vat. This series of closely spaced perforations 35 extend throughout the length of the vat 6. In width said perforations spread between two parallel plate plates 36 extending into the vat and also spread between the filter frame 33 and the upper front chamber wall 6. Otherwise, the vat 6 is itself sealed when in the walling of the closed chamber 2. Consequently, the vat 6 has its interior in communication only through the vapor filters 35 and the filter frame openings 34 with the rear air and vapor duct 31, 140 and the front lateral air passages 5, 26, as well as with other parts of the sealed chamber 2. In other words, the filter frame 33 extends from one side wall 22 of the machine to the other side wall 22 thereof and in effect forms part of the down-draft air and vapor duct 31, 140 at the rear of the work-treating chamber 2, because the two inside forward plates 31 and 33 are both joined with the rear circle of the vat 6 and with the latter constitute the front inside wall 6, 31, 33 of said duct, while the spaced cabinet wall 146 defines the rear wall thereof.

20 A number of vapor filters or screening delliners 37 are nested in the frame 33 by securing said filters within the frame openings 34. One of the filters is shown detached from the machine and is illustrated in Figure 7. Each filter preferably consists of the pressed fabric metal sheet material, and is held down by a spreader, a suitably shaped wire frame 38, with the open mouth of the bag secured to an end ring 39 on which the front end of the spreader frame 38 is carried. Each assembled filter 37 is mounted through an opening 34, and the end or mounting ring 38, as a base for the filter device, is then appropriately secured to the frame plate 32. Thus the air and vapor filter bags 37 project horizontally to the rear and into the upper part of the down-draft air and vapor duct, following the rear wall 140, so that the filtered vapor coming through the cloth bags 37 can blow down said rear duct and into the condenser chamber RC.

25 On the other hand, the open mouths of the filters 37 are forward of their retaining frame 33 and above the rows of vat perforations 35. The filters receive the solvent vapor with entrained lint as it blows upwardly from the perforated washing drum 7 and out through said vat perforations 35 into the open mouths of said filters. The wet lint collects on the inside surfaces of the filter bags 37, while the clear air or vapor (depending upon the cycle in progress) escapes through these mesh bags into the passage behind the filter frame 33.

30 The nest of filters 37 is accessible at the front of the dry-cleaning machine through a rectangular opening 40 formed in the slanting upper front wall 8. A removable cover plate 41 is provided down by any suitable means, say hand screws 42 (Figure 1), thus sealing the opening 40 after the vapor filters 37 have been delinted, cleaned, and remounted in their retaining frame 33. Any suitable vapor filter frame can be placed in the upper portion of the work-treating chamber 2 between the vat perforations 35 and the rear vapor passage adjacent the back wall 140. It will be understood, therefore, that the filters and other parts are shown as an example of one satisfactory form of construction.

35 From the foregoing, it will be appreciated that a closely coupled and unified internal work-treating chamber 2 has been produced. By inside walls and partitions, welded in place as described, a unitary and sealed chamber is formed, one which requires no frame work to support its parts. The several inside compartments or sub-chambers are grouped around the cylindrical washing vat 6. For example, the vapor-filtering chamber for the rest of vapor filters 37 is above the vat 6 and is part of the “air and vapour” passage below the vat there is closely grouped on the same level the single recovery-condenser chamber RC, the two air-heater chambers HB, with the solvent-dump tank DT therebelow. Behind the vat is the down-draft duct 31, 140, and at the front there is the lateral air duct 5, 26. These several sub-chambers and their connecting passages are compactly grouped within the walling arrangement forming the work-treating chamber 2 in general and constitute a unitary part thereof.

40 It is noteworthy that my design and construction includes a minimum number of walls and partitions due to the fact that this invention makes common one wall or partition to two or more sub-chambers and their connecting passages. All internal compartments or sub-chambers, with their related vessels for handling the solvent, will be shown to be彼此 independent against communication with the outer atmosphere, but all these members are internally vented to one another by means later described as my special intervening system, by which I am able to produce a uniformly steamed dry cleaner and operate it at about atmospheric pressure.

45 Referring back to the block-off valve port 29 at the front of the recovery-condenser RC, a description of the parts accessory thereto will now take
be given. It is noted that a similar valve port 44 is made in the lower front wall 5 of the sealed work-treating chamber 2. It opens from the outside of the machine into the lateral-air passage 5, 28 leading to both air-heater boxes HB. This valve port 44 is ordinarily referred to as the deodorizing-inlet valve because it admits fresh air from the outside into the machine at the end of the dry-cleaning operation to aerate and refresh the work, should that be required. This deodorizing-inlet valve port 44 is in axial alignment with the bleed-out valve port 25 of the condenser chamber RC. These two valve ports 44 and 25 have their seats spaced apart sufficiently to accommodate a large volume of air flow therebetween and have a single valve head 45 operative in common to both ports. This valve 45 may be pneumatically operated to automatically close first one port 25 and then the other port 44 in accordance with the later-described cycle operation of the machine.

A valve stem 46 (Figure 5) carries the valve head 45 and is reciprocally guided in a pneumatic diaphragm housing 47. The housing is shown in two separate convex halves with a flexible diaphragm 48 peripherally sealed therebetween. A spring is preferably provided under compression on the valve stem 46 between a shoulder therein so as to normally seat the valve 45.

The deodorizing-inlet port 44, by deflecting the diaphragm 48 to the left, when there is no air pressure in the housing. An air-pressure tube 49 is connected with the outside member of the diaphragm housing 47. This pressure tube 49 is adapted to be connected with a source of air pressure (not shown) to deliver a shot of air against the flexible diaphragm 48 to deflect it to the right, thereby reversing the setting of the valve head 45. This action closes the condenser chamber block-off valve port 25 and opens the deodorizing-inlet port 44 (Figures 12 and 13), thus admitting fresh air from the outside of the machine into the lateral passage 5, 28.

The combination deodorizing-inlet and recovery-condenser block-off valve 45, with its pneumatic operating means 47, is merely one example of several of my forms of my valve, and it is shown diagrammatically to explain the principles of this invention. In my commercial form of construction (Figure 1), this pneumatic actuator 47, 48 is set flush into the front wall 5 of the sealed chamber 2. The air tube 49, with other later named, is adapted to be under the control of an automatic pilot or cycle timer CT for controlling the pneumatic actuator 47, 48 and hence the action of the valve 45, and also for performing other cycle actions of this machine.

The cycle timer CT is shown (Figure 1) mounted on the left side of the machine and is known by its trade-mark "Formatrol" which is suggestive of its function, this being particularly true of such device when it is used on water-washing machines adapted to automatically control the proportions of the washing-liquid formula to attain the proper percentages of the several ingredients constituting said washing mixture. It is only alluded to herein, since the cycle timer pertinent to the subject of the present invention, although well adapted to control the cycle actions of this dry cleaner. Just briefly, this automatic pilot has a slowly rotating cycle-timer record CTR in the form of an insulator-disc record perforated with time-contact slots, through which perforations a number of contact fingers are adapted to automatically effect electrical make-and-break contacts with a metallic disc under said record for opening and closing the valve 45, as well as numerous other valves later described. This automatic pilot also has an optional control in the form of a bank of cycle-timer push buttons CTR which are adapted to be manually depressed to control the same valve 45 and said others, when the operator does not wish to use the automatic record CTR for that purpose.

The fresh cool air, drawn into the lower part of the sealed dry-cleaning chamber 2 through the large open deodorizing-inlet port 44, divides when it impinges the valve head 45 (Figures 12 and 13) and flows laterally in both directions to the open front ends of the two chambers HB, which are not heated at the time. Thence, the air will be shown to pass through the air and vapor deluting filters 37, and then discharges from the closed chamber 2 back to atmosphere through a deodorizing-outlet valve 50, located at the upper part of the machine, the means for which will now be more fully described.

A pair of air and vapor conduits 52 (Figure 6) connect the rear of each heater box HB with the perforated washing drum 7 near the axis of the latter. These conduits are mounted on the side walls 2 of the machine, a blower box being included in each conduit. An electric motor 54 drives each blower in a direction to draw the air from the rear of both heater boxes HB and propel it upwardly, as indicated by the direction arrows. Figure 1 shows one electric motor 54 mounted on the drive shaft of one blower 53 connected in communication with an air conduit 52 to propel the air upwardly therethrough, the entire assembly of which in this instance is compactly placed on the outside wall 2 of the work-treating chamber. The other side of the machine in Figure 1 of course carries a duplicate motor and blower assembly, as will be appreciated from the several views of the drawings. In Figures 2 and 3, for convenience the same reference character 52 points to the holes in the side walls 2 of the machine adapted to receive the upper and lower ends of the pair of air ducts 52.

The upper end of each air conduit 52 opens into the inner circle of a stationary air-distributing flange or ring 55, one of which is secured on the inside of each end wall of the unit 6 within the sealed dry-cleaning chamber 2. These two flanges 55 are concentric with the washing drum axis 8. Each head or end of the washing drum 7 is swaged or dished inwardly at its central portion to form a rotating air-receiving pocket 56 flanged over the ring 55 at each end of the drum. Perforations 57 are punched through each dished pocket 56 and open into the drum 7. The two flanges 55 and 56 are concentric and telescoped, the outer one revolving in close relation to the inner fixed ring. The two nested flange means 55, 56 provide an effective transfer of the air flow from the conduits 52 at each side of the machine into the rotating drum or washing receptacle 7. Thus the two motor-driven blower units 54, 55 deliver a blast of air into each end of the rotating drum 7, the object of which is to first recover the saturated solvent from the work, thereafter dry out said work by rapid vaporization, and finally deodorize the work (an optional step) by sucking fresh air in through the deodorizing-inlet valve 44.

The blast of air (hot, cool, depending on the cycle) enters each end of the drum 7 and passes through the work being tumbled and agitated
therein, and then escapes upwardly through the drum perforations T, out through the vat perforations 35, thence through the vapor or air filters 37, and into the rear upper portion of the sealed dry-cleaning chamber behind the filter frame 33. At this point it is to be said that, if the deodorizing-inlet valve 44 at the lower part of the machine is open (Figures 12 and 19), likewise, the deodorizing-outlet valve 50 at the upper part of the machine is also open, and the fresh air then passes from the filters 37 out of the chamber 2 through said outlet valve 50. But if both deodorizing valves 44 and 50 are closed (Figures 10 and 11), the air blows through the filters 37 and down the rear vapor duct along the wall 440 into the condenser chamber RC.

With further reference to the deodorizing-outlet valve 50, it is to be understood that it is illustrated diagrammatically. It is shown as a flap or swing valve 58 and is pivotally mounted within a housing 59 having a large-discharge port 99 comparable in size to the previously described inlet-valve port 44. The flap valve 50 is pneumatically operated and is adapted to automatically open and close its port 99 simultaneously and in step with the opening and closing of the previously explained deodorizing-inlet port 44 by the valve head 45. The valve housing 58 is set over a large discharge opening 60 cut through the left side wall 2 of the machine adjacent and behind the left end of the next air filters 37. For clarity in illustration, I have shown (Figure 5) the deodorizing outlet valve 50, 58, mounted on top of the sealed chamber 2 with the lower reference-leader line 66 indicating the hole in the side wall 2, and the upper leader line 68 pointing to a duct (in dotted lines outside the machine) extending up to and opening into the valve housing 58. On the other hand, a suitable mounting for this deodorizing-outlet valve housing 58 is on the left side wall 2 of the machine, as shown in Figure 6 and other views.

The pneumatically controlled deodorizing-outlet valve 50, 58 in actual practice of course can be made in a compact unit of different form than here shown, but the function and principle of this element of my general combination is clearly shown (Figure 5) where the valve flap 50 is fixed on a shaft 61 journalled to turn freely within the valve housing 58. This operating shaft 61 may be packed with a stuffing box where it passes through the wall of the housing 58 and its outer end is fixed to an arm 62. Any suitable actuator is connected with the arm 62 for automatically opening and closing the swing valve 50. In this instance, an air cylinder 63, supported on the valve housing 58, with a suitable piston and connecting rod, is operatively connected with the valve arm 62. A coil spring is shown in dotted lines under compression in the cylinder 63 and is adapted to normally maintain the piston to the left, and hence the valve 50 is held tightly sealed over the deodorizing-outlet port 99.

An air-pressure supply tube 64 connects with the left end of the cylinder 63, and a pneumatic-relay valve 65 is included in this air tube. When the relay valve 65 opens, by reason of its adaptation to the remote control from the cycle timer CT, a shot of air from the tube 64 energizes the servo-motor unit 63, pushes its piston to the right-hand end, and further compresses its actuating spring inside the cylinder. This opens and holds open the valve flap 50 against the compressed spring (dotted in cylinder 63) so long as the relay valve 65 remains open to apply static-air pressure to the piston in the little cylinder 63. The relay valve 65 shown, is merely schematic to illustrate my principle and mode of operation. This relay valve 65, like other air-pressure valves in my machine, may be either adapted to be pneumatically or magnetically operated, but is shown here as a small pneumatic with a piston actuated cut-off foot or plug valve (in dotted lines) to open and close the main air-supply tube 64 through the agency of a relay-air tube 61, one end of which is suitably connected with the small cylinder 63 and the other end broken off but in practice is connected with an electro-pneumatic valve unit (not shown) under the control of the cycle timer CT.

It is to be noted that the dotted T (Figure 5), representing the unit piston and foot valve 68, is shown in down position thus stopping the air flow in tube 64 at said valve 68, so that the servo-unit 63 is not energized, and the deodorizing-outlet valve 50 remains closed. This type of remote-control pneumatic relay-actuated valve 65 is shown at other points (Figures 8 and 9) in my drawings, by way of example only, and is adapted to be either under the automatic program control of the cycle-timer, or if the machine is set for full-automatic operation, or under the control of the cycle-timer buttons CTB2 if set for manual or semi-automatic operation.

Next, a description is made of the improved solvent-dump valve 68 and its strainer 69, the latter being known as a button trap. These members are shown in Figures 2 and 3 in one of their preferred commercial forms, while in the other views (Figures 4 and 5) this unit 68, 69 is illustrated diagrammatically in connection with the solvent system to be described. This dump valve and button trap assembly 68, 69 places the washing vat 6 in drain communication with the solvent-dump tank DT. After a washing or rinsing operation in the vat 6, the dump valve 68 is pneumatically opened, and then the dirty solvent drains from the vat 6 by gravity and strains through the elongated button trap 69, into the underneath sump or soliied solvent-receiving tank DT, whereupon the washing drum 1 is immediately ready for its high speed extracting cycle. The solvent flow is rapid down through this button-trap dump valve due to the passages therethrough being large, hence the quick-flow or dumping function thereof.

Preferably, a solvent-drain channel 70 is made longitudinally in the bottom of the washing vat 6. This channel is pitched (Figures 2 and 3) to rapidly drain the soliied solvent toward the left side of the machine, where the solvent enters the dump valve housing 68 but is held against flow by a normally-closed swing valve 71 fixed on a vertical pivot shaft 72 journalled in the dump-valve housing 68. The shaft 72 is fixed in a hub on the outer end of a rockcr arm 74 projecting from a slotted or open side pneumatic cylinder 74 adapted to rock the shaft to open and close the dump-valve flap 71 mounted in its housing 68.

The small cylinder 74 is similar in function and operation to the pneumatic relay-controlled actuator 63 heretofore explained and constitutes a servo motor to actuate the dump valve 71. In fact, the previously described servo-motor 63 and its deodorizing-outlet valve 50 are preferably manufactured as a unit in the same compact form as this servo-motor unit 74 now being de-
scribed. This cylinder 74 contains a piston adapted to be driven in one direction by air pressure to open and hold open the swing valve 71 long enough to permit all the solvent to drain from the vat 6. Thereupon the cylinder 74 is vented and a compressed spring therein returns the piston and the dump valve 71 to their normal positions to shut the latter and close the drain channel 70 at its lower end where it enters the dump-valve housing 69. The air tube connection and its relay control from the cycle timer 73 are not shown, but are in a similar arrangement to one or more servo actuators heretofore explained, for example like the pneumatics 47 and 63 shown in Figure 5.

The solvent-dump valve 71 has assumed its open position in the views (Figures 2 and 3) under consideration, where the direction arrows show the soiled solvent draining from the dump-valve housing 69 into the top of the button-trap housing 65. The soiled washing liquid is flowing through a screen or perforated metal strainer 75, and the bottom clean-out connection 76 leading into the dump tank DT. A hand-screw-anchored cap or lid 77 covers the large open top end of the button trap 69. This cover 77 is easily removed, whereupon the strainer 75 is drawn, and the deposit is emptied therefrom. The waste matter usually consists of buttons, pins, buckles and what-not which falls from clothing during the dry cleaning process carried out in the washing and dry-tumbling cylinder 7. Hence, the button trap 69, 75 is located in an accessible position and is easily cleaned out from time to time, which prevents foreign matter from returning back into the machine to clog the solvent pipe lines.

At this point in my description, it is well to note that the cover 77 is also removable from the upright cylindrical button-trap housing 69 for the purpose of initially introducing the required amount of solvent into the machine. The fresh solvent is strained as it flows directly into the dump tank DT, whence it eventually is transmitted by pumping means (later described) to the sealed storage tank ST located somewhat inaccessible inside the cabinet part I and is without the usual fill cap opening.

From the foregoing, it is noted that my improved dump valve 69 and strainer unit 68, 69 (Figures 2 and 3) comprises a compact assembly of three housings, to wit, the upright strainer or button-trap housing 69, with the dump-valve casing 68 attached to the upper end thereof and opening into the side thereof, and the pneumatic servo motor 74 enclosing its actuating parts and mounted upon the dump-valve housing 68. These three elements are assembled as a unit and mounted on the side of the machine. Note that the top connection 76 of any suitable form, with the top-flanged connection at the rear of the dump valve housing 68, constitute the two mounting points which make the entire assembly easily detachable from the machine and accessible for cleaning and adjustment. The same reference characters heretofore used, are also applied to the dump-valve button trap 68, 69 and actuator 74 assembly shown diagrammatically in Figures 4 and 5, to which views I am now about to refer as I come to a description of the soiled solvent-handling and refining system connected in series with the sealed dry-cleaning chamber 2.

While in Figures 2 and 3 I have illustrated the washing vat drain channel 70 pitched to the left because the dump valve 69 is there shown on the outer left side of the machine more like the commercial apparatus, said channel 70 in the several other views is accommodated to a diagrammatic showing necessitated by reason of Figures 4 and 5 comprising flow sheets showing in one plane all major parts of the combination solvent flow system and sealed dry-cleaning chamber 2. In view of this latter arrangement, as an expedient in illustrating my invention, I have shown a pipe 78 (Figures 4, 5 etc.) leading from the bottom center of the washing vat 6, hence from a level-drain channel 70 in these views, to the dump valve 69 located to the rear of the dry-cleaning chamber 2. In these views, the same reference 76 (as used in Figures 2 and 3) points to the bottom pipe connection leading from the button trap 69 into the dump tank DT. Thus, in Figures 4 and 5 the soiled-liquid solvent flows from the vat 6 through pipe 78, through the dump valve and strainer 68, 69, and through the bottom connection 76 into the dump tank DT.

The force-feed valve 80 has been shown to be the closed work-treating chamber with its related parts shows that I have provided a compact construction, wherein all inner or sub-compartments and passages are closely placed, thereby eliminating conventional canalization and channeling, which makes for power economy in the electrical apparatus for circulating the air and vapor incident to drying the work and recovering the solvent.

The solvent system in general

While in the foregoing, some features of the solvent-handling system have been explained, I now come to a more complete disclosure thereof, by which my new combination as a whole will be understood.

Reference is first made to Figure 4 inasmuch as this view is devoted to a showing of the solvent and vapor flow circuits with the pressure intervening lines, comprising the solvent-recovery and refining apparatus in series with the work-treating chamber 2. This view gives me in space to a description of Figure 5, as I come to a consideration of all liquid and vapor flow circuits, comprising the steam and the cold-water lines employed for heating the air used in drying the work, for cooling various condensing coils, and also for separating water from the refined solvent to purify it.

Having filled the dump tank DT through the button trap 69 by removing its cover 77 (Figures 2 and 3) as heretofore explained, the batch of fresh solvent is transferred to its place of first use through a force-feed pipe 80 having a junction with a still pipe 81 and a by-pass storage tank pipe 82. The piping 80, 81 connects the dump tank DT with the upper end of a still S65 for distilling the solvent, while the piping 80, 82 can be used to by-pass or cut out the still S65 and deliver the liquid batch to a solvent-storage tank ST carried in the upper part of the motor compartment I of the cabinet behind the closed-washing chamber 2.

The force-feed pipe 80 includes a solvent pump 84 to either deliver the liquid through the still pipe 81 to rotating spray nozzle 79 within the top of the still S65, or to the storage tank ST above the
vat 5, depending upon the setting of valve means provided in the two pipe lines 81 and 82. The tank ST is closed and sealed from the atmosphere and ordinarily does not have a fill opening. An electric motor and transmission 85 (Figures 6, 8 and 9) drives the solvent pump 84 through a belt as shown or other suitable transmission means. The solvent-pump and motor unit 84, 85 are not shown in detail, since any suitable pumping means may be employed. This motor and transmission means 85 is preferably under the control of the cycle timer CT so as to be automatically operated by its record CTR in step with the cycle action of the machine, or under the optional manual control of one of the cycle-timer buttons CTB.

A valve 86 is placed in the still-feed pipe 81, and a valve 87 is in the storage-tank feed pipe 82. Preferably, these two valves 86 and 87 are pneumatically remote-control relay-operated by the cycle timer CT. A two-way valve can of course be placed at the junction where the pipe 80 connects with the still branch 81 and with the tank branch 82. However, by closing the still-branch valve 86 and opening the storage-branch valve 87, the solvent flows in the direction of the valve directly from the dump tank DT into the storage tank ST by forcing the liquid through a filter 88 placed in the line 82 beyond the valve 87. Thus, new solvent is preferably delivered directly to the storage tank ST where it is ready for use in the distillation vat 6. A glass-sight gage 83 (Figure 1) of well known form connects with the top and bottom of the storage tank ST and is mounted on the side wall 2 of the machine to show at a glance the solvent level and hence the quantity in said tank still.

Under certain conditions, used solvent is clarified in the by-pass filter 88 by pumping it through this filter instead of refining it in the still S. A batch of solvent, in the dump tank DT, comparatively free of water but contaminated with dirt or lint, can be pumped through the filter 88 to strain out this solid matter, whereupon the filter core is removed, cleaned and replaced. The condition of the solvent and the work to be dry cleaned, and the personal equation or desire of a particular operator, are factors which govern the use of the optional use of the still S and the filter 88. The solvent pump 84 is common to both. The pump and filter pipe line 80, 82 can also be used to flush out the washing vat 6, the dump tank DT, their pipes and passages, thus washing out the sediment from time to time by collecting it in the filter 88.

The storage tank ST is located above the washing level WL (Figure 5) in the vat 6. Hence, the stored solvent flows by gravity through a solvent-inlet valve housing 90, having a large flap or swing valve 91, opening from the bottom of the storage tank ST, and through a pipe or neck 92, into the side of the washing vat 6, as shown. A pneumatic actuator 92 has its piston operatively connected with the pivot on which the valve 91 is carried. The pneumatic actuator 92 may be designed along the lines of the valve actuators hereinbefore described. A solenoid or other actuator may be employed instead. Its function is to automatically open and hold open this inlet-dump valve 91 long enough to fill the vat 6 either with new or recuperated solvent to a predetermined washing level WL. The valve 91 is snapped closed by a spring forming part of the servo unit 92 and also by the weight of solvent bearing down on the valve when the servo unit is deenergized.

During this vat-filling operation from the tank ST, the vat outlet or dump valve 88, 71, previously explained, is of course closed and is held closed by the servo unit DT. It is also understood that the deodorizing-inlet and outlet-valve ports 44 and 59 are likewise closed, in preparation for the beginning of a run of work, after a batch of soiled clothes has been placed into the washing drum 7 through the machine door 9 which is now also closed.

It will be seen that a reverse setting of the two solvent-control valves 86 and 87 is made for the purpose of conveying to the still S the soiled solvent containing water and grease accumulated during any dry-cleaning operation in the chamber 2. Thus, by closing the tank-branch valve 87 and opening the still-branch valve 86, the motor-driven pump 84 forces the dirty solvent from the dump tank DT to the still S where it is refined and cleaned, and in the course of conveying it to the storage tank ST, the recuperated solvent is further purified by separating the water therefrom. This refining cycle, and other operating steps in their sequence, will be described later on, since at this time I wish to continue with a description of the construction of a portion of parts constituting the closed solvent system in series combination with the closed-washing chamber 2.

Any suitable refining still S can be employed in this solvent system. The one shown as an example includes the vaporizing inner still receptacle 8 with a steam jacket 93 and an outer shell 94 as an insulating cover. A bottom clean-out plug 95 is provided in the usual way to remove the still, grease, lint and foreign matter PM which accumulates in the bottom of the still receptacle as a result of repeated distilling operations. A steam-supply pipe 96 is adapted to be connected with a steam boiler or source of steam (not shown) to furnish an adequate supply of steam for my dryer cleaner system, i.e., for the still S as well as the heater boxes 97-98 herefore mentioned. A still-branch steam pipe 97 leads from the supply pipe 96, through an interlock-valve housing 98 (Figure 5), and thence into the steam jacket 93. The steam circulates through the jacketed still, heats the vaporizing receptacle S, and returns to the boiler to a steam tank 91, otherwise is discharged through an outlet pipe 99 leading from the jacket bottom.

The flow of the steam through the pipe 97 to the still S is controlled by the hydraulic and spring pressure-actuated interlock valve 99 (Figure 5) before mentioned. This valve is shown open and the steam piping 96, 97 is feeding steam to the still jacket 93. The cylindrical housing 98 has a valve stem 100 carrying a piston on one end movable in the cylinder as shown, and a valve head is fixed on the other or lower end of said piston rod or valve stem and is adapted to seat upon and close a steam port shown connecting the two pipes forming the steam branch 97 in which this interlock valve 98 is included. A spring 101 seats against one end of the housing 98 and pushes against the valve head and stem 100, thereby urging said valve closed to shut off the steam flow in pipe 97 leading to the still S.

A water line 102 has one end opening directly into the upper end of the interlock-valve cylinder 100 as shown, and the other end of the water intake or water supply pipe 102 is so arranged that when the water pressure in line 102 is statically maintained it follows that the piston and valve rod 100 overcomes the upward force of the valve spring 101 and keeps said valve stem 100 down.
with its valve open as shown. Hence, the normal static water-pressure existing in the cylinder of the valve housing 98 serves to keep the steam line 97 open to heat the still S. However, should the water pressure in the line 102 drop off for any reason (as later discussed) it is clear that the valve spring 101 will push the valve stem upward instantly closing the valve 98 and shutting the steam branch 91, with the result that the vaporizing function of the still will be safely and positively stopped. The other end of the hydraulic line 103 is connected with a still-condenser cold-water pipe 106 later described, and it will now be explained how cold water line 102, with its hydraulic valve 96, constitutes a safety interlock between the still S and its still condenser SC about to be described.

The still S has a vapor flue 104 leading upwardly to a still condenser SC. Baffle plates as shown are usually set into the flue to retard the updraft of the heavier or liquid particles of solvent carried by the vapor rising from the steam-heated still and to drain these heavier ends back into the still for revaporization, while the lighter vapor exits from the pipe. The flue 104 opens into the still-condenser chamber SC under a set of cooling-condenser coils 105 mounted in heat-exchange relation within this chamber. The coils 105 are usually fnnished or grilled to increase their contact area. A cold-water pipe 106 delivers cold water through the still-condenser coils 105, the water entering the lower bank of coils adjacent the vapor flue 104 and discharging through a pipe 107 to the sewer or a storage tank for further use.

The water pipe 108 is a branch leading from a main water-supply pipe 108 connected with the city water main, or other adequate source, to furnish cold water not only to the cold-radiating coils 105 in the still condenser SC, but also to the recovery condenser RC, as later explained. A valve 109 is placed in the cold-water branch 108 adjacent the main-supply cold-water pipe 108. It is an automatic remote-control relay-operated valve and it is adapted to govern the cycle action of the still condenser SC, as later explained, under the control of the cycle timer CT.

It was herebefore explained that the hydraulic pipe 102 is interconnected between the still-condenser cold-water branch 106 and the cylinder still housing 98. Thus, it is seen that so long as the cold-water valve 109 is open, cold water flows upwardly through the branch pipe 106, circulates through the still-condenser coils 105 and enters the pipe 102. This action applies hydraulic pressure on the piston and valve rod 100 in the valve housing 98 to hold open the steam pipe 91 to the still S. This arrangement interlocks the steam pipe 91 for heating the still with the cold-water pipe 106 for cooling the still condenser coils 105, so that any failure or misoperation of the cold-water flow to said coils 105 acts to drop the hydraulic pressure in the interlock pipe 102 which instantly stops the flow of steam to the still S.

Accordingly, the still S and its condenser SC are interlocked for joint operation. They are off and on together under the control of the still condenser SC in the interlock pipe 102. This keeps the combination piston-rod valve-stem 100 in downward position to maintain a constant flow of steam through the pipe 91 into the steam-heating chamber 93 of the still, so that the still S cannot distill unless its condenser SC is simultaneously condensing. The still S, therefore, cannot generate an internal vapor pressure in the system.

The still condenser SC and its water separator WSI

The refined solvent condensed by the still condenser coils 105 collects in the bottom of the chamber SC and is still warm when it drains by gravity down a solvent-flow pipe 110 into the upper end of a vertically-disposed solvent cooler, sometimes called the intercooler, the major function of which is to cool and separate water from the distilled solvent and thus finally purify it. I have given this element in my new combination the suggestive reference character WSI since it is the first water separator to be described. I will later describe a second water-separating means WSI which operates in conjunction with the recovery condenser RC.

A solvent-flow pipe 111 conducts the cool and purified water-free solvent from the bottom of this vessel WSI into the upper end of the storage tank ST. Inasmuch as the still condenser SC is located several inches (say six to nine inches) higher than the top of the storage tank ST, as indicated by the solvent gravity-flow tilted line Fl (Figure 4), it follows that the solvent flows by gravity through the piping 110, 114 and the cooling vessel WSI into the top of the vessel or tank ST. This storage tank is of ample size to take the full output of solvent refined by the still S and its condenser SC and de-watered through the agency of the vessel WSI. The still S may be kept in operation until all the solided solvent is pumped from the dump-tank vessel DT, then refined, purified, and conveyed by natural gravity flow to the tank ST and there held ready for use in the washing vat and drum 8, 7.

It is understood by those conversant with the art why the solied or used solvent in the dump tank DT at times contains a large percentage of water. This is due to the moisture in the clothes being dry cleaned and moisture in the atmosphere which enters the closed chamber 2 when the door 3 is opened. Clothes to be dry cleaned sometimes contain as much as 12% moisture by weight. The distilling operation in the still S serves to remove from the solvent the dirt and grease therein. This foreign matter FM accumulates at the bottom of the still S (Figure 5) and is removed from time to time through the clean-out plug 95 to maintain the efficiency of the still. However, the boiling and vaporizing of the solvent in the still S simply means that the water content rises as steam through the vapor flue 104 with the solvent vapor into the still condenser SC. The cold-water coils 105 cool and condense the mixed water and solvent vapor, both flowing down the pipe 110 into the water separator WSI which is also chilled in furtherance of its water-cooler function. A cold-water coil 112 is mounted in heat-exchange relation within this vessel WSI and is in series with the cold-water branch 106 leading from the main-supply cold-water line 108 to the cold-radiating coils 105 in the still-condenser chamber SC. The intercooler water-separator coils 112 first receive the cold water which gives it maximum efficiency, and the water then flows through the still-condenser coils 105. The result is that the cold-radiating coils 112 rapidly cool the refined condensed solvent and water solution flowing down.
the pipe 110 and entering the vessel WSI in a mixed state.

As much as chilling the solvent greatly reduces the affinity for water absorption and, since the solvent is heavier than water, the result is that when the solvent and water emulsion or mixture starts pouring down on the chilling coil 112, the solvent, upon becoming chilled immediately releases the water, separation thus taking place. The pure dewatered solvent now flows downwardly in the vessel WSI and up through the pipe 111 to the storage tank ST, as previously explained, under the head of gravity pressure due to the still condenser SC being located at a higher altitude than the tank ST. On the other hand, the free water rises to the top of the water separator WSI and floats on the solvent. The solid arrows indicate solvent flowing downwardly, while the dotted arrows show water flowing upwardly as noted in Figures 4 and 5. Thus a mixture of solvent and water (solid and dotted arrows) is indicated as flowing down the pipe 110, both entering the separator WSI the two liquids chill and separate.

The water (dotted arrows) floats to the top of the solvent cooler and water separator WSI and rises in an intertubing coil 113 which interconnects the upper part of the two vessels SC and WSI which are sealed from atmosphere. A water draw-off pipe 114 taps the intertubing or free-water riser pipe 113 and drains the water to a closed water-receiving vessel 115 adapted to accumulate the separated water from the intertubing WSI. The water receiver 115 can be emptied from time to time by opening its drain valve 116 at the bottom thereof.

The water draw-off pipe 114 taps the free-water riser and intertubing coil 113 at or near the tilted gravity-flow line FL (Figure 4) heretofore mentioned. Consequently, the bottom of the still-condenser chamber SC is higher than this water draw-off pipe 114 so that the free water readily overflows into the water receiver 115. By the same arrangement, the junction of the draw-off pipe 114 with the pipe 113 is also a little higher than the upper end of this storage-tap solvent-feed pipe so that water-free or pure solvent readily overflows from pipe 111 into the tank ST before said solvent can rise in the pipe 113 to the level of the water draw-off pipe 114.

From the foregoing, it is now understood that the gravity flow line FL indicates a comparative small net drop in altitude (seven or eight inches) from the still condenser SC to the storage tank ST, and that during this gravity flow the previously refined solvent is further purified by separating all water therefrom in the intercooler WSI. Hence, the storage tank ST always contains cool and pure solvent ready to be dumped by the large inlet valve 96, 91 into the washing vat 6 of the sealed dry-cleaning chamber 2.

The heat-box steam coils, the cold-water coils in the recovery condenser, and water separator WSI

A set of steam-heated coils 120 is mounted in each heater box HB in heat-exchange relation and receives steam from the main-steam supply. By so doing, a branch steam pipe 121 therefrom to said coils. In other words, the steam supply pipe 96 connected with a boiler (not shown) has its first branch 97 connected with the still S as previously explained, while a second steam branch 121 is understood as being connected with the two heater coils 120. As an expedient, this branch-steam pipe 121 is shown broken away (Figure 5) but it is to be seen (Figures 8 and 9) as a steam feed, and during the first bank of heat-radiating coils 120 located on the right side of the machine, or at the lower part of the sheet in said Figures 8 and 9. The heating coils 120 are usually made with fins or a grilling to increase their radiating area.

The steam-feed branch 121 includes relay-actuated steam-control valves 122 preferably under the remote control of the cycle timer CT, as will be understood. At any rate, this steam valve 122 stops and starts the flow of steam to the two sets of heat-radiating coils 120 to heat the air boxes HB and the air flowing therethrough in accordance with the cycle action of the machine. The two steam coils 120 are here shown connected in series by a cross pipe 123, and an outlet or return pipe 124 leads from the second bank of coils 120 in the left heater box HB (at top of sheet) and is adapted to extend back to a boiler. This supplied piping thus provides one feed pipe 121 with one steam-control valve 122 and a return line 124, although a separate steam-feed line and return for each bank of coils 120 may well be provided. Either arrangement affords a pair of high-temperature chambers HB for heating the air passing over the banks of coils 120, as the air comes from the fume or recovery condenser port 29, on its circuit back through the air conduits 52 and into the dry-tumbling drum T where it vaporizes and carries away the solvent retained in the work after extraction. By heating the air, its affinity for the solvent is greatly increased so as to promote vaporization and recovery of the solvent from the work, and consequently rapid drying of the work is effected. Thus is explained the function of the steam-heated coils 120 in the two air-heating chambers HB.

The foregoing emphasizes the importance of the fume or recovery condenser RC which is compactly placed between the two air-heating chambers or boxes HB. Having heated the air flowing in a circuit through the dry-cleaning drum T to more rapidly vaporize and wash the work, it is conveyed thencefrom, it becomes the function of the recovery-condenser chamber RC to condense and recover the solvent vapor and fumes from the warm air drawn through the washing drum 7, through the filters 37, down the vapor duct 31, 140 and into said recovery chamber RC. To this end, a bank of cold-radiating coils 126 is mounted in the solvent-recovery chamber RC to condense and precipitate the solvent out of the air. This is accomplished as the warm vapor blows between and over the cold coils 126 forwardly through the chamber toward the port 29. The condensed solvent drips from the cold coils 126 and collects on the bottom 141 and drains to the center and to the rear of the chamber RC. This recovered solvent is dirty and contains water as a result of having been used in the washing operations. It flows from the drain plate 141 into the dump tank DT, and through a water separator WSI0 later explained.

A refrigerating coil 126 can be employed in heat-exchange relation within the recovery condenser RC if desired, but I have largely neglected, so have shown herein the cold-water radiator 128. The coils shown are purely diagrammatic, since in actual practice a fine-tube type or radiator grill is ordinarily used to increase the cold-radiating surface area thereof. The recovery-condenser chamber RC with its cooling coils is
made adequate in capacity to condense the solvent and water vapors as rapidly as the latter are released from the work, as will be understood by those conversant with the art.

The recovery-condenser coils 126 are fed with a continuous flow of cold water through a branch pipe 127 leading from the large cold-water supply pipe 108 to the upper or rear coil 126. The cold water cools and condenses this coil-radiating unit, absorbing the heat from the contacting solvent vapors, and the water (now becoming warm) is carried off through an outlet pipe 128 leading to the sewer or a water-storage tank. A cold-water control valve 129 is included in the water-fed branch RC 121 to the recovery-condenser coils 126. This valve 129 is preferably an automatically relay-actuated valve of the pneumatic servo-motor type, the same as I have adopted throughout my machine for the cycle actions thereof under the control of the automatic pilot CT.

From the foregoing, the cold-water system used in my machine is readily traced, since for convenience I have shown a large pipe line 108 (Figure 5) as the cold-water supply, with a valve-controlled branch 106 to the intercooler coils 112 of the water separator, as before described, and another valve-controlled branch 121 to the recovery-condenser coils 126 within the chamber RC. The cycle action of this solvent-recovery condenser RC is later described in connection with the general operation of my machine, but its water-separating device WS2 will now be explained.

An appreciable water content is present in the solvent fumes and vapors wafted down the air and vapor duct 31, 146 and subsequently condensed by the cooling coils 126 in the solvent-recovery chamber RC 121. This is due to the fact that the continuous hot-air flow or flow through the saturated work in the drum withdraws the solvent and water from the garments being dry cleaned, the water moisture being the last to vaporize but nevertheless being brought out by the hot air drying medium. The result is that the condensate is not only contaminated with dirt and grease but also contains some water as the liquid drips onto the drain bottom 141 under the coils 126. The soiled solvent and water condensate thus recovered in the chamber RC flows gravity out through a drain pipe 131 into a water-separating vessel WS2, the second one in this invention. The water-free solvent then flows from the vessel WS2 through a pipe 132 into the dump tank DT. This recovery-condenser water separator WS2 acts upon a solvent and water mixture of temperature low enough to effect release of a substantial portion or even all of the water from the solvent. In fact, a refrigerant or cold-water coil may be placed in the vessel WS2 if desired in further aid of water separation, as shown in the first water separator WS1, but conditions are not such as to necessarily require it.

The pipe 131 leads down into the vessel WS2 near the bottom thereof where it discharges its mixture so the latter can spread out within this vessel. The water, being lighter liquid (dotted arrows), now floats to the top of the heavier solvent. The solvent (solid arrows) gravitates to the bottom where it enters the pipe 132 connected with the tank DT. The upper end of this water-separating vessel WS2 is above the top level of the tank DT, so by gravity, the liquid (dotted arrows) overfow and follow the water (dotted arrows) out through a water overflow pipe 133 into a closed cold water receiving vessel 135 (Figure 5) having a normally closed drain valve 136 which is occasionally opened to empty the water from said vessel. Note that the water draw-off pipe 133 is located above the solvent level in the water receiving vessel 135. The remaining liquid condensed from the atmosphere but the inflow of separated water from the water separator WS2 readily takes place.

A check valve 134 (Figures 4 and 5) is usually placed in the pipe 132 below the solvent level SL. This check valve 134 prevents the solvent from backing up in the water separator WS2 from the dump tank DT in the event a high level of solvent is accumulated in said dump tank before it is pumped through the pipe line 88 back to the still S for refining.

The operation of the foregoing recovery-condenser water separator WS2 substantially aids in reducing the solvent of water which is a difficulty always present. Although this device WS2 only separates the water from the solvent coming from the condenser RC, and does not treat the solvent coming direct from the vat 6 through dump valve 66 into the dump tank DT, nevertheless the use of this second or supplemental water separator greatly increases the efficiency of my machine and takes some of the load off the still S. In other words, by separating out a major portion of the water from the solvent before it enters the pipe line 88 going to the still S, it follows that the still is relieved of vaporizing, and the still condenser SC of condensing, by just that amount of water which was previously subtracted from the solvent by my second water separator WS2.

It will now be seen that the only water which goes to the still S is the comparatively small percentage thereof in the solvent which is drained from the vat 6 through the dump valve 66, 14 after each washing and rinsing operation. Since the washing and rinsing operations accumulate less water in the solvent than the air-drying operations, it usually follows that more water is taken out by this recovery-condenser water separator WS2 than the first water separator WS1.

All solvent apparatus and vapor circuits are sealed and intervented.

My invention provides a dry-cleaning machine and mode of operation which renders it more practical and economical than ever before to internally seal the whole of the apparatus from contact with the outer atmosphere during operation. It will be understood by those conversant with the art that this invention has advantages in attempting to operate a closed-system dry cleaner either under a vacuum or at a pressure above that of atmosphere. Since my closed machine is used and operated at about atmospheric pressure, there is a minimum tendency toward atmospheric breathing. Liquid (dotted arrows) is always present to cause outside air to seep into this machine or inside fume and vapors to escape therefrom to the outside.

It has already been explained that the several internal and closely coupled condenser coils or sub-chambers form the large dry-cleaner chamber 2 are integrally formed by the welded-in walling and partition arrangements, and the welded construction is especially effective in pre-
venting solvent seepage and loss, it being understood that solvent is volatile, penetrative, and difficult to confine. The welded-in fabricated construction also makes a self-braced design forming a unitary one-piece from chamber 2 of the cabinet within which the work is washed and dried, and the solvent recovered. All compartments and passages are closely grouped and connected to occupy a minimum of space. All parts are sealed within the one large chamber 2, against atmospheric communication, so that in effect the only time the inside of my machine is in contact with the outer atmosphere is when the door 3 is opened to introduce or remove work from the drum 1.

In view of the foregoing, it will be understood that the few movable or detachable parts, which might subject the work-treating chamber 2 to leakage or atmospheric breathing, are suitably sealed by stuffing boxes, gaskets, and packing, which expedients are indeed few in number due to a minimum of solvent joints and connections in the machine. This solvent-return means, on its gasket by the camming handles 11, and the filter inspection door plate 41 is fastened down air and vapor tight by hand screws 42. The deodorizing-valve ports, i.e., the inlet 44 and outlet 45, and other accessories, this solvent-return means also serves the purpose of keeping the exterior of the machine clean and free of solvent moisture.

The bearing housing 136 varies in form, but it contains a cavity adjacent the packing 137 to receive any solvent which may seep through the stuffing box means 138. This solvent seepage is returned through a small tubing 136, 139 connecting the stuffing-box bearing 136 to some near-by solvent chamber, say the drum tank DT or other inside vessel. A coil 139* forms a liquid lock in the lower tube 139 which may be connected with the drum tank DT. This coil 139* fills and remains full of solvent by the drippings from the stuffing-box bearing 136, and thereby prevents air or vapor communication, i.e., breathing, between the outer atmosphere and the inside of the machine, which might otherwise negligibly occur through the small tube 139 and its sight-drip cup 141. A check valve 139* in the tube 139 may be preferred to the liquid lock 139*.

Such check valve allows the solvent to drain down the tube 139 into the drum 138, but positively prevents the escape or out-breathing of air or vapor therefrom. The open cup 141 is right under the tube 139 to receive the drippings from the bearing 136, and such cup is preferably provided in the solvent return tubing so the operator may observe the drippings and thus have some knowledge of the wearing conditions of the bearing and adjust or renew its packing 137 when abnormal solvent seepage is observed at the cup 141.

In actual practice, I have successfully used a solvent bearing and stuffing-box 136, with a sight-drip cup or other indicator 141 with the two-piece return tubing, similar in principle to the foregoing. While this machine usually employs a sealed solvent return means with drip or bearing-leak indicator 141 at each end of the washer drum 8, I have in the apparatus described on this device on one shaft end only, it being obvious how the device is made to serve any exposed bearing to save the solvent and keep the sides of the machine clean, as well as prevent the negligible air or vapor breathing in or out of the machine at one or more bearings. Therefore, to consistently illustrate this machine as being completely sealed, in keeping with its principle, I have shown the special solvent-return bearing and tubing at that end of the shaft 8 which carries the drive pulley 23, while on the other end a capped bearing 142 seals over the dead end of said shaft 8. Thus both ends of the shaft 8 are provided with air-tight closure means.

I have now outlined the principle and several means employed to attain a positively sealed work-treating chamber 2, which it will now be noted is connected in series with the solvent piping system. By this series connection is meant that the dirty solvent piping 80, 81 leads from the bottom of the sealed chamber 2 back to the still 8, while the return purified-solvent piping 110, 111 leads from the still condenser SC to the storage tank ST, and then through the inlet-dump valve 80, 81 into the dry-cleaning chamber 2. The chamber 2 at one end of the solvent piping and the still S and its condenser SC at the other end thereof, taken all together, constitutes a closed-solvent circuit.

The dirty liquid thus tracked through the closed-solvent circuit 80, 81 is transferred up the pipe 3 to the sealed intercooler WS which is merely transferred up the pipe 3 into some other part of the closed vapor circuit when the

The vapor interbreather pipe 113, previously mentioned, vents the upper end of the closed intercooler WSI into the closed still condenser SC and other parts of the system as will be explained, but has no connection with the atmosphere. Consequently, the liquid solvent and water mixture flows freely down the pipe 113 into the liquid phase intercooler or water separator WSI due to the fact that the intervent pipe 113 prevents the upper end of the sealed intercooler WSI from becoming air bound. The air or vapor at atmospheric pressure within the sealed intercooler WSI is merely transferred up the pipe 113 into some other part of the closed vapor circuit when the...
liquid flows down into said intercooler and causes such transfer or vapor displacement. The same condition is true of the receivers 115 and 135 which are normally sealed against atmospheric venting. As the water in the separator WSH is released from the cooling solvent and overflows into pipe 114 and down into the water receiver 115, the air and vapor in said closed receiver are displaced and escape upwardly through the piping 114, 113 to some other closed vessel in the system. The suction pipe 114 is sufficiently large to admit of the upward passage of the air therethrough from the receiver 115 as the separated water trickles down said pipe, or another intervent tube (not shown) can be interconnected between the upper end of said water receiver 115 and the interbreather pipe 113. Likewise, the interbreather tube 143 keeps the water vessel 135 sealed from atmospheric air venting by virtue of the fact that it connects with some other vessel of the system as shown.

An interventing pipe 144 places the upper part of the closed-storage tank ST in breather communication with the closed receivers and hence with other closed vessels of the solvent system. Likewise, a pipe 145 connects the upper part of the closed chamber 2 with the pipe 144 and hence with other closed members of the system. Furthermore, the sealed dump tank 155 is intervented to all other sealed-vessel members, and this can be accomplished by interconnecting an internal breather tube (not shown) between the upper part of said tank and with the breather pipes or pipe 145. A simpler expedient (Figure 5) is to provide an intervent orifice 146 in the upper portion of the dump-tank cover 141, with an upper rim or flange so as not to permit solvent to pour through this hole into the tank DT. This inside vent 146 intercommunicates the sealed dump tank DT with the entire insides of the work-treating chamber 2, thereby opening the tank for an internal breathing action out through the recovery condenser RC and its opening 30 into the vertical vapor duct 31, 140, and also out through the block-off valve port 29 into the natural air duct 28, 20 leading through the heater boxes HB and air conduits 52 into the wash drum 7. Conversely, the last named parts can breathe in back into the dump tank DT.

The explanation just made of the vapor breather pipe or pipe 144, together with the orifice 146 in the top of the tank DT, makes it clear that the vapor or air space within the upper portion of each solvent vessel in the apparatus is intervented to the upper vapor space of every other vessel. Hence, the top portions of all vessels can breathe in and out to all others. This interventiated communication between the air and vapor spaces of all solvent vessels in the apparatus affords cumulatively a very large volumetric capacity of interbreather space, and makes it possible for liquid to readily flow by gravity or pressure from one vessel to another in the system without becoming air bound or liquid locked, despite the fact there is no outside air or atmospheric vent or vents whatsoever.

The transfer or flow, therefore, of a body of liquid solvent from one vessel to another simply disturbs a like volume of vapor from the latter back to the former. Take one example as a test of the fact just stated, by assuming that the storage tank ST is full of solvent. The opening of the dump valve 90, 91 permits a full charge of the liquid to quickly flow by gravity into the wash vat 6. The outflow is not retarded from the tank ST by reason of the absence of an atmospheric air vent from the top of the tank ST, which ordinarily is understood or thought to be essential in order to prevent a vacuum from forming above the liquid as it flows out. This is not so in my apparatus because the tank ST is intervented to the receding pipe 114 to which the liquid flows. Consequently, the displaced air or vapor transfers back from the vat 6 through the intervent tube 145 to break the vacuum which otherwise would form above the receding pipe 114. The direction and mode of flow promotion applies in the same way to all other parts, tanks, chambers, and vessels in the chamber 2 and in the solvent system connected therewith.

Although my dry-cleaner system normally operates at about atmospheric pressure and therefore does not require the conventional pressure outlet or vent as will now be understood, nevertheless there is provided a safety valve 148 (Figures 4 and 5) which remains normally closed. The valve 148 is placed at some high point in the vapor pipe 114 and hence to vapor escape valve. In the present example of my invention, this valve is mounted in the intervent lines, say in the breather pipe or pipe 144. The valve consists of a weighted head which remains sealed 114 and hence to the entire apparatus. A suitable housing mounts the valve head 148 as shown. It is readily seen that this valve 148 is not a breather valve because it acts as a check valve against the inflow of air to my closed-solvent system and chamber 2. The valve head 148 is weighted to lift or open at a pressure just above atmospheric pressure, say a two pound pressure or less.

The foregoing normally-closed safety valve 148 has as its purpose to provide against the eventuality of wear or imperfect seating of the hydraulic pressure-controlled steam valve 98, i.e., the valve head on the lower end of the piston stem 100 which controls the inflow of steam through the pipe 97 to the still S. Due to long use, wear, or grit on the valve seat, the sticking of the valve stem 100, or other factors beyond my control, the spring 101 might not at some time fully seat and close the valve 98 and thus fail to positively shut off the steam line 97 to the still S. Such might be the occurrence some time when the hydraulic line 102 drops its pressure, or when the machine is shut down and the cold-water valve 109 is closed in the pipe 106 to the still condenser SC. In view of the foregoing, there might result, unknown to a casual operator, a slow distilling operation due to the continued slow feed of steam to the still jacket 93. Such liquid solvent as happens to be in the still might therefore be vaporized and flow upwardly into the still condenser SC, but the condensing coils 105 having cooled off the vapors might not condense and precipitate into the intercooler WSI in the normal way. Or if the vapor did condense, the intercooler WSI not being cold might not separate the water, with the result that water might get in the pipe line 111 and contaminate the solvent in the clean-solvent or air from the latter back to the former. Take one example as a test of the fact just stated, by assuming that the storage tank ST is full of solvent. The opening of the dump valve 90, 91 permits a full charge of the liquid to quickly flow by gravity into the wash vat 6. The outflow is not retarded from the tank ST by reason of the absence of an atmospheric air vent from the top of the tank ST, which ordinarily is understood or thought to be essential in order to prevent a vacuum from forming above the liquid as it flows out. This is not so in my apparatus because the tank ST is intervented to the receding pipe 114 to which the liquid flows. Consequently, the displaced air or vapor transfers back from the vat 6 through the intervent tube 145 to break the vacuum which otherwise would form above the receding pipe 114. The direction and mode of flow promotion applies in the same way to all other parts, tanks, chambers, and vessels in the chamber 2 and in the solvent system connected therewith.

Although my dry-cleaner system normally operates at about atmospheric pressure and therefore does not require the conventional pressure outlet or vent as will now be understood, nevertheless there is provided a safety valve 148 (Figures 4 and 5) which remains normally closed. The valve 148 is placed at some high point in the vapor pipe 114 and hence to vapor escape valve. In the present example of my invention, this valve is mounted in the intervent lines, say in the breather pipe or pipe 144. The valve consists of a weighted head which remains sealed 114 and hence to the entire apparatus. A suitable housing mounts the valve head 148 as shown. It is readily seen that this valve 148 is not a breather valve because it acts as a check valve against the inflow of air to my closed-solvent system and chamber 2. The valve head 148 is weighted to lift or open at a pressure just above atmospheric pressure, say a two pound pressure or less.

The foregoing normally-closed safety valve 148 has as its purpose to provide against the eventuality of wear or imperfect seating of the hydraulic pressure-controlled steam valve 98, i.e., the valve head on the lower end of the piston stem 100 which controls the inflow of steam through the pipe 97 to the still S. Due to long use, wear, or grit on the valve seat, the sticking of the valve stem 100, or other factors beyond my control, the spring 101 might not at some time fully seat and close the valve 98 and thus fail to positively shut off the steam line 97 to the still S. Such might be the occurrence some time when the hydraulic line 102 drops its pressure, or when the machine is shut down and the cold-water valve 109 is closed in the pipe 106 to the still condenser SC. In view of the foregoing, there might result, unknown to a casual operator, a slow distilling operation due to the continued slow feed of steam to the still jacket 93. Such liquid solvent as happens to be in the still might therefore be vaporized and flow upwardly into the still condenser SC, but the condensing coils 105 having cooled off the vapors might not condense and precipitate into the intercooler WSI in the normal way. Or if the vapor did condense, the intercooler WSI not being cold might not separate the water, with the result that water might get in the pipe line 111 and contaminate the solvent in the clean-solvent or air from the latter back to the former. Take one example as a test of the fact just stated, by assuming that the storage tank ST is full of solvent. The opening of the dump valve 90, 91 permits a full charge of the liquid to quickly flow by gravity into the wash vat 6. The outflow is not retarded from the tank ST by reason of the absence of an atmospheric air vent from the top of the tank ST, which ordinarily is understood or thought to be essential in order to prevent a vacuum from forming above the liquid as it flows out. This is not so in my apparatus because the tank ST is intervented to the receding pipe 114 to which the liquid flows. Consequently, the displaced air or vapor transfers back from the vat 6 through the intervent tube 145 to break the vacuum which otherwise would form above the receding pipe 114. The direction and mode of flow promotion applies in the same way to all other parts, tanks, chambers, and vessels in the chamber 2 and in the solvent system connected therewith.
tank DT. There is a possibility, however, that the misoperation of the still S might continue, due to a leaky valve 81 or perchance some other cause. Such an eventuality might in time pro-
duce an undue or unsafe internal vapor pres-
sure, although it is to be noted that the vapor would gradually cool and reliquify as it spreads throughout the cool internal spaces of the ma-
chine. However, the unlikely vapor pressure will be relieved through the safety valve 148, and no danger to the machine arises.

The safety or pressure-relief valve 148 rarely if ever functions, but it is provided for the re-

time conditions above explained, as a possible

abnormal cause and effect in my machine.

General operation, the wash, rinse, and

extraction

A batch of soiled work or clothes W (Figure 10) to be dry cleaned is now distributed in the wash-
ing pockets of the drum S, and the door 9 is sealed
down. The cycle timer CT, when set for auto-
matic control, is adapted to start the motor
means 20 in the rear cabinet compartment 1 upon closing the door 9, or if set for manual con-
trol the proper button CTB is manually de-
pressed. At the same time, the solvent-inlet
valve 91 is opened by its pneumatic 92, and a predetermined quantity of the wash liquid pours
into the vat 6, to a good washing level as at
WL, whereupon the valve 91 snaps closed. The motor means 20 and transmission 22 rotates the drum 7 a few turns in one direction, reverses and goes in the opposite, and repeats this back and

forth wash tumbling oscillation until the clothes are solvent washed by agitation.

The outlet-dump valve 71 then automatically opens through the agency of its relay-actuated pneumatic 74, and the dirty solvent drains from the vat 6 into the dump tank DT. Before rinsing the washed work, there can be an intermediate extraction, accomplished by the cycle timer CT which now cuts out the reversing-slow oscillating motor in the compartment 1, and cuts in the

high-speed one-direction motor to spin the drum
7 at high speed in a counter-clockwise direction, as viewed in Figure 5. The solvent saturated in the work is centrifuged out, pours down through the open dump valve 71, strains through the but-
ton trap 83, 76, and collects in the dump tank DT. The scraping baffle plates 86 aid in prevent-
ing the solvent, which floats out from the perforated drum 7, from passing upwardly through the vat slots or perforations 35 and also from being thrown on the hinged part of the door 9.

Having extracted for a time, the dump valve
71 closes, the motor means 20 switches back to its reversing-slow drive, the inlet valve 91 again
opens and dumps in a batch of pure solvent for a rinse-tumbling operation. Several rinses, with an extraction from time to time, cleanse the work, and make it ready for the drying opera-
tion. During the foregoing washing and rinsing
cycles, the dump tank DT has accumulated a large batch of dirty solvent, and the solvent-re-
fining cycle may now begin.

The solvent pump 84 (Figures 4 and 5) is started, the valve 81 in the filter by-pass pipe
52 being closed, with the valve 80 open in the still pipe 81, and the force of the solvent dis-
charging from the rotary nozzles 79 throws the solvent (heavy arrows) against the hot walls of the still S. The cycle timer CT has also opened

the water valve 106 in the cold-water pipe 106 which suitably lowers the temperature of the coil 112 in the solvent-intercooling water separator WS1 and also cools the still-condenser coils 105 for the condensing action. The flow of cold water through the pipe 106, 107 provides pressure in the hydraulic line 102, the piston actuated valve stem 100 goes down and opens the steam line 97, thus the still is now heating, and solvent vaporization is starting.

The vapors (light arrows) rise through the still

flue 104 and are cooled and precipitated by the still-condenser coils 105. This distilled solvent contains a certain amount of water, and the mix-
ture still warm flows down through the pipe 110, the action of which tends to mix or emulsify the solvent and water (solid and dotted arrows), but upon striking the cooler and water-separator coils 112 water separation (dotted arrows) takes place, as previously explained. The free water overflows upwardly into the receiver 115, but the purified,
distilled, and water-free solvent flows down through the pipe 111 and up into the storage tank ST. In this way, fresh steam accumulat-
ing in the tank ST for further washing and rinsing cycles, while at the same time the batch of work (Figure 10) is being dry cleaned in the drum 7.

The operator has the option of clarifying the solvent, or any portion thereof, by pumping it through the filter line 82. For example, if the solvent is not overly soiled, or has settled in the dump tank DT over night, he can close the still valve 86, open the filter valve 81, and pump the portion of solvent which is clear through the filter 88. A batch of filtered solvent is thus quickly obtained in the storage tank ST, while wait-
ing perhaps for a batch of refined and dewatered solvent from the still S, which of course can be carrying out its operation on a batch of soiled solvent previously pumped thereinto.

The optional control of the two solvent branch-
line valves 86 and 87 is provided for in the cycle
timer CT which, although not the subject of the present invention, is nevertheless understood to have the bank of manual push-button controls
CTB shown in Figure 1, as heretofore explained. Such a provision in the cycle timer makes it either full or semi-automatic, whereby the numerous relay-actuated servo-motor valves and the operation of the driving-motor means 20 possess a flexible operation either under the will of the operator manually executed through the cycle-
timer buttons CTB or under the program control of the automatic cycle-timer record CTB to ef-
flect the several steps in sequence. During the foregoing washing, rinsing, and ex-
tracting operations, it was unnecessary to have started the flow of steam to the heater boxes HB, or the cold-water flow to the recovery condenser RC. Hence, the steam valve 122 and the cold-
water valve 123 remained shut by reason of the cycle timer CT not yet having opened these two valves to their respective coils 120 and 126. Neither were the motor-driven blower units 53, 54 started while the foregoing washing, rinsing, and extracting cycle was in progress. The de-
odorizing-inlet port 44 and outlet port 59 of course remained closed.

Dry tumbling, hot-air drying, solvent recovery, cooling down the work, Figures 9, 10 and 11

Having solvent washed the work as above ex-
plained, the hot-air drying step now starts. Dur-
ning such drying cycle, the solvent system and
still S may of course be in operation, or at least completing its refining treatment, on one or more batches of used solvent, as hereinbefore explained. The drying cycle now starting, the recovery condenser RC and its water separation WS2 are brought into use.

The cycle timer CT now opens the steam valve 122 and steam from the main-supply pipe 26 flows through the branch pipe 121 and circulates through the beds of heating coils 120 in the two heater boxes HB. Also, the cycle timer opens the cold-water valve 129 so that cold water from the supply pipe 108 now circulates through the recovery-condenser coils 126 and leaves the machine through the outlet pipe 128. Likewise, the cycle timer now starts the two motor-driven air-blowers units 53, 54, and the air within the closed chamber 2 begins to circulate through the drum 7 which is now dry tumbling, i.e., oscillating the work W as before explained. By reverse tumbling the work in the radial pockets of the drum 7, the air comes in closer contact therewith and with more rapidly vaporizes and carries off the solvent. During this hot-air drying cycle, the deodorizing-inlet port 44 and outlet 59 still remain closed, while the recovery-condenser block-off port 29 is open.

The hot-air blows along a complete circular course within the closed chamber 2, and none escapes to atmosphere. Hot air is the vehicle for carrying the solvent and water moisture from the work, and the same air is used over and over again. How all parts of the dry-cleaning chamber 2 are sealed, including the shaft 8 and its main bearings, has been explained. The two blowers 53 force the air saturated with solvent and water vapors from the drum 7 out through its perforations 7, thence through the upper vat openings 35, on through the air filters 51, down the rear vapor duct 31, 140 through the opening 30 into the rear of the recovery condenser RC, and forward against and over its cold coils 126. The solvent and water vapors are cooled by contact with the cold coils 126 and precipitate from the air as liquid on the drain boards 141, but the dry and vapor-free cold air blows out through the port 29 against the valve head 45 seated over the deodorizing-inlet port 29. Here the vapor-free cool air divides and goes in both directions through the lateral passage 5, 28 in the two air-heater boxes HB, and blows against and along the bank of steam-heated coils 120 thus being reheated. Again the hot air is forced by the blowers 53 up the two air ducts 52 and into the drum 7 as the point of beginning. Heated air has a maximum affinity for solvent absorption as it blows through the drum 7, picks up the solvent, and again starts on its circuit through the dry-cleaning chamber 2.

Hence, the air travels around and around as a solvent and moisture carrying vehicle, being reheated in the two air-heater chambers HB, and picking up the solvent from the saturated work in the drum 7 for recoiling as it blows through the recovery-condenser chamber RC where it gives up the solvent which drips from the condenser coils 126 down on to the drain plate 141. The recovered solvent and water then passes through the water separator WS2, serving the recovery condenser RC, and into the dump tank DT.

Inasmuch as the nest of filters 37 effectively remove the lint from the vapor, and the water separator WS2 takes out the water from this reclaimed solvent, it follows that said reclaimed solvent, flowing from the pipe 122 into tank DT, is in a fair state of recuperation. This makes the action of the still S fast and efficient when this reclaimed and pre-heated solvent is pumped to the still for refining.

At this point I wish to explain that the capacity of the still condenser SC is made adequate to condense as rapidly as the still S vaporizes the solvent; while at the same time the capacity of the recovery condenser RC is also adequate to condense as rapidly as the hot-air blast drives the solvent from the work in drum 7 and brings it to said chamber RC. This explanation is made so that it may be seen that in the event both vaporizing means (the still S and the hot-air blast in the work chamber 2) is in operation at the same time, that neither condensing chamber SC nor RC will be overloaded, with a resultant escape of vapors therefrom into some other port of the sealed system. This cannot occur, so long as the two sets of cold-radiating coils 105 and 126 absorb the heat as rapidly as the vapors enter the respective chambers SC and RC.

In connection with the foregoing paragraph, it is to be noted that the cold-water control valve 109 for the still-condenser coils 105, as well as the cold-water control valve 129 for the recovery-condenser coils 126, are both completely open. True enough, I desire to provide a hand-throttling or flow-regulating valve in the cold-water feed pipe 108, but such valve is set for local conditions and ordinarily left at some predetermined degree of opening by which to provide a constant flow through the two sets of condensing coils 105 and 126. In fact, it may be preferable to also place a throttling valve in the branch pipe 106 and another in the branch 127, rather than rely upon the one cut-off or throttling valve in the main water pipe 108. In all cases, however, each automatic off-and-on cold-water control valve 109 and 129 provides the maximum flow of water to its condensing coil, depending upon the setting of the manually-adjusted valve in the respective pipes, when the cycle timer acts to open said automatic valve or valves.

Having hot-air blasted the work W in the drum 7 for some minutes, it is now completely dried, all the solvent has been recovered therefrom, although it is left comparatively hot. The work now being dry, the blower 53 continues to blow hot air. Cooling down the dry and hot work is next in order and comparatively simple. The steam control valve 122 is closed to shut off the flow of steam to the two heater-box coils 126, but the cold-water control valve 129 is left open to continue the cooling of the coils 126 in the recovery condenser RC. This change in operation very quickly results in a circulation of cold air through the drum 7, on the same circuit as described before, while the drum continues to tumble the work.

The heater boxes HB cool down very quickly, and the air coming down the rear air duct 31, 140 is cooled every time it passes through the recovery condenser RC, which now has a very high chilling effect because it is no longer acting as a condenser on a warm medium, but is functioning merely as a cooling radiator. The coils 126, therefore, very quickly attain their maximum low temperature, equivalent to the temperature of the cold water or other refrigerant circulating therethrough, and the dry-cleaned work in the drum 7 just as quickly cools down to a like temperature.

The completeness of the cooling-down cycle just explained, where未曾提到的未处理过的溶剂被泵送到蒸馏设备进行蒸馏。
Deodorizing cycle consisting of sucking into the sealed chamber 2 fresh air from the outside to cool down, deumec, and freshen the work in the drum 7. In other words, the extraction and re-
covery of the saturated solvent and water con-
tents of the airborne smoke is thus thorough-
ough by reason of the efficient operation of the hot-air closed circuit and the large capacity re-
covery condenser RC that no fumes or odor is left
in the work. Consequently, it is not always nec-
essary to go any further than to carry out the cool-
down cycle just described.

It is for the foregoing reason, of not requiring the deodorizing cycle, that I have disclosed my
invention in a modified form in Figure 4. This view shows the sealed work-treating chamber 2 without the deodorizing-inlet port 44 and with-
out the deodorizing-outlet port 59, while the other views show these valved communications with the
outer atmosphere for deodorizing. In Figure 4, it is clear that the construction is simplified and comprises less parts, yet the mode of opera-
tion is the same as heretofore explained.

Considering the non-deodorizing form of my invention in Figure 4, the lower front wall 56 is a solid wall and not fitted with the combination automatic valve 45, as shown in other views, for alternately opening and closing the deodorizing-inlet port 44 and the solvent
block-off valve port 28. Figure 4 simply shows the front plate 28 of the recovery-condenser left open. In fact this front plate 28 may be omitted. Hence, the front end of the recovery-condenser chamber RC is wide open more like the front open ends of the air-heater boxes HB. To the same effect, note that this modified form also omits the showing of a deodorizing-outlet valve 58, so that the large outlet 60 in other views is not to be seen in the side wall adjacent the nest of filters 37 in Figure 4. This modified form of sealed work-treating chamber 2 is without any mode of outside air intake and air discharge, ex-
cept through the door 9 which is sealed down during a dry-cleaning run, and except for the safety valve 148 which is weighted down and does not open during normal operation.

In some dry-cleaning establishments, or with some operators, there is a preference to deodorize as a final step before the work is thought probably being just flushed through the fume or vapor duct 125 in the fume or vapor-recovery condenser RC 60 by holding open the cold-water shut-off valve 129 (Figure 8) in order preferably to maintain a low
temperature in the recovery condenser while the
deodorizing operation is in progress. In view of this low temperature in the recovery condenser, it follows that a partial vacuum or lower-air pressure condition tends to form in said chamber RC, due to condensation and a cooling down of the air therein. This low-pressure condition has a tendency to draw downwardly the heavier vapor or
particles, if any, which might possibly be carried in the fresh air at the time it flows through the filters 37 and just prior to discharging outwardly through the side-wall opening 60 leading to at-
mosphere through the port 99. Unless the oper-
ator had previously perfected the solvent-recovery cycle, there might now exist some tarry sol-
vent in the air when he comes to deodorize.

From the foregoing, it is noted that the design and construction of my machine provides for solvent recovery even during deodorizing or de-
fuming, such recovery taking place in the event the user of this machine did not previously hot-air dry the work and by cold-air cool it down,
but preferred to depenu more upon deodorizing.

Deodorizing, as shown in Figures 12 and 13
To start a deodorizing operation, the cycle
timer CT sets the two deodorizing valve means 45 and 50 in the position shown in Figures 12 and 13,
which is to say that the block-off valve head 45 is actuated to open the outside-air inlet port 44 and close the block-
off recovery-condenser port 29. The deodorizing-
outlet valve 50 is also actuated to open the out-
let port 59.

The proper valve settings for this cycle of opera-
tion can be effectuated optionally, say manually through a cycle-timer button CTB, or automatic-
ly through the cycle-timer record CTR, de-
pending upon the particular way the operator
prefers to set the automatic pilot CT of his ma-
chine. In either case, this setting of the deodor-
izing apparatus simply provides for a flow of out-
side fresh air through the perforated washing
The work has preferably been cooled down as heretofore explained, and op-
eration which followed the hot-air drying cycle, as
explained at the end of the previous topic herein.

The blowers fans 53 have been continued in op-
eration from the previous cycle, and they now
begin to draw the air through the inlet port 44 in both directions along the laters along the
ports 38, 28, thence through the air-heater boxes HB (not
heated at this time), up through the conduits 52 and
into the washing drum 7. From the latter, the fresh air passes out through the perforations 7a of the drum, up through the openings 35 in the vat 6, then through the filters 37, and finally out through the side-wall opening 60 where the air discharges back to atmosphere through the deodorizing-outlet port 59. This flow of fresh air through the work is brought into play by some users to freshen the work and remove any re-
mainning traces of odor.

As much as the combination valve 45 has posi-
tively closed the recovery-condenser port 29, it will be noted that there is no forced down draft
along the rear air and vapor duct 31, 140, and
consequently the air leaves the porous filters 37 and
blows out through the deodorizing outlet 59 and
valve port 59. It will be understood, of course, that the steam-heated coils 126 in the
heater boxes HB had previously cooled down by
closing the steam-control valve 122 (Figures 8
and 9) during or toward the end of the previous cycle of drying out, by which to effect the cooling-
down step heretofore discussed. Accordingly, cool
fresh air from the outside is now circulated through the already cooled-down work and this
fresh air removes any traces of fumes or odors
which might have remained in the work after the
previous cycle was completed. As before stated, however, the prior cycle of hot-air drying and
cold-air cooling down removes all traces of odor
from the work when the machine is properly used
and the operating cycles carefully timed.

In this deodorizing cycle, the cold water may
well be left to continue its flow through the
block-off valve head 125 in the fume or vapor-recovery condenser RC 60 by holding open the cold-water shut-off valve 129 (Figure 8) in order preferably to maintain a low
temperature in the recovery condenser while the
deodorizing operation is in progress. In view of this low temperature in the recovery condenser, it follows that a partial vacuum or lower-air pressure condition tends to form in said chamber RC, due to condensation and a cooling down of the air therein. This low-pressure condition has a tendency to draw downwardly the heavier vapor or
particles, if any, which might possibly be carried in the fresh air at the time it flows through the filters 37 and just prior to discharging outwardly through the side-wall opening 60 leading to at-
mosphere through the port 99. Unless the oper-
ator had previously perfected the solvent-recovery cycle, there might now exist some tarry sol-
vent in the air when he comes to deodorize.

From the foregoing, it is noted that the design and construction of my machine provides for solvent recovery even during deodorizing or de-
fuming, such recovery taking place in the event the user of this machine did not previously hot-air dry the work and by cold-air cool it down,
but preferred to depenu more upon deodorizing.
therefore. It is more practical, however, to continue the prior cycle of hot-air drying out and cold-air cooling down for a sufficiently long period to remove all solvent odor and fumes from the work before reaching the deodorizing cycle, then testing and adjusting. Such recommended efficient use does not require the deodorizing valves at all, so that the simpler and modified form of sealed chamber 2, as shown in Figure 4, is to be preferred. On the other hand, if the deodorizing cycle is used, it will be noted that the required or negative atmospheric-pressure condition in the recovery condenser RC will tend to draw down thereinto the heavier solvent vapors just as they emerge from the filters 37 and before they pass out of the chamber 2 through the opening 58.

An important feature to note is that the combination valve 45 has positively shut and blocked-off the recovery condenser port 29 so that no outside fresh air whatsoever comes in contact with any solvent which may not have completely drained from the cold recovery-condenser coils 26 and the drain plate 141 out through the pipe 131 into the dump tank DT. In this way, I have positively shut or blocked-off the solvent system of my machine from the air flow taking place while deodorizing. Consequently, no recovered solvent will escape or get out through the deodorizing outlet valve port 55 because the whole of my solvent-handling apparatus is sealed from the atmosphere.

Although the dump tank DT contains liquid solvent, it will be seen that any vapor solvent or fumes which may rise through its intervent 146 will be condensed snod thereto liquefied, and will eventually return to said dump tank. As the vapor rises through the vent 146, said vapor may be condensed immediately by the cold coils 26 in the solvent-recovery condenser RC. However, if wafted through the port 29, the vapor will flow the air-drying and recovery circuit in the sealed chamber 2, and comes back down the air and vapor duct 140, 31, thence into the rear end 45 of the cold chamber RC where said vapors are subjected to chilling by the coils 26. Hence, solvent vapor which rises from the dump tank is recovered.

Another instructive point to be noted is in connection with the intervent 145 at the top of the sealed chamber 2. When deodorizing, that is, when drawing fresh air into the sealed chamber through port 44 and discharging it from port 60, 59 (Figure 5), any solvent vapor which may tend to come from the pipe 145 into the chamber 2 is pressed back by reason of the air flowing out through the deodorizing outlets 60 and 59. Consequently, the deodorizing pressure or air flow acts to automatically drive the solvent fumes back toward the still condenser SC, or into the storage tank ST, and thus conserve said fumes or vapor, at any time the deodorizing-outlet valve 55 is open.

This invention fills a need felt for either a full-automatic or a semi-automatic dry cleaner, one capable of flexible use at the will of the operator, whereby he may at any time take over the control of the machine the use of the cycle-timer buttons CTR, or allow the machine to continue automatically under the control of the cycle-timer record CTR.

It is to be understood that changes and equivalents can be introduced into my construction without departing from the principles of the invention and the advantageous uses of this machine, as taught in the foregoing specification. What is claimed is:

1. A cabinet for a dry cleaning machine comprising, in combination, external walls formed of top and bottom with side and front and rear plates the meeting edges of which are joined together to enclose therewithin an upright work-treating chamber of sealed construction; partition means inside the upright work-treating chamber forming internal compartments, such as a horizontal, washing-liquid receptacle mounted about midway between the top and bottom of said chamber, a washing-liquid recovery-condenser compartment under said receptacle, an air and vapor passage formed between the rear external wall and receptacle to connect said receptacle and condenser compartments, the walls and said partition means being common to said internal compartments and said passage; openings through the upper portion of the washing-liquid receptacle serving to communicate the latter with the upper end of the air and vapor passage, and a dump tank formed in the bottom of said work-treating chamber under the condenser compartment.

2. A cabinet for a dry cleaning machine comprising, in combination, walls formed of plates at the meeting edges of which are joined together to enclose therewithin a work-treating chamber of sealed construction; partition means inside the work-treating chamber forming internal compartments, including a washing receptacle, a vapor-filter compartment above said receptacle, an air and vapor passage at the rear of said chamber leading downwardly to a recovery-condenser compartment formed under said washing receptacle, a lateral air passage at the front of said chamber leading from said recovery-condenser compartment to an air heating compartment forming internal sub-compartments, including a washing-liquid receptacle, an air and vapor passage leading therethrough, a recovery-condenser compartment connected with said passage, a passage leading from said recovery-condenser compartment into two air-heater boxes, one on each side of said recovery-condenser compartment, all of which are grouped in close relation to each other, the wall plates and said partition means being common to the said receptacle, the passages, the compartment, and the air-heater boxes; and communication between the closely grouped sub-chambers established by openings formed through the partition means to reduce to a minimum the distance traveled by the washing liquid, as well as the air and vapor, in flowing through said passages and openings from one compartment to another.

3. A cabinet for a dry cleaning machine comprising, in combination, wall plates the meeting edges of which are welded together to form an upright work-treating chamber of sealed construction; partition means inside the work-treating chamber forming internal sub-compartments comprising a washing-liquid receptacle, an air and vapor passage leading therethrough, a recovery-condenser compartment connected with said passage, a passage leading from said recovery-condenser compartment into two air-heater boxes, one on each side of said recovery-condenser compartment, all of which are grouped in close relation to each other, the wall plates and said partition means being common to the said receptacle, the passages, the compartment, and the air-heater boxes; and communication between the closely grouped sub-chambers established by openings formed through the partition means to reduce to a minimum the distance traveled by the washing liquid, as well as the air and vapor, in flowing from one sub-chamber to another.

4. A cabinet for a dry cleaning machine comprising, in combination, walls formed of plates the meeting edges of which are welded together to form therewithin a work-treating chamber
sealed from atmospheric contact; partition means inside the work-treating chamber forming several internal sub-compartment, such as a washing-liquid receptacle, a dump tank receptacle, air and vapor passages connecting said receptacles, a washing-liquid recovery-vat, partition means, air-heater compartments, all of which are located in close relation to each other, the wall plates and said partition means being common to the several internal compartments; and communication between the several closely related compartments established by openings formed through the partition means to reduce to a minimum the distance traveled by the washing liquid, as well as the air and vapor, in flowing from one compartment to another, and to permit a shifting or transfer of the air and vapor from one compartment to another by which internal venting is accomplished.

5. A cabinet for a dry cleaning machine comprising, in combination: spaced upright side walls, front and rear walls, with top and bottom walls, all integrally joined along their meeting edges and forming therewith a washing and drying chamber which is adapted to be sealed from atmosphere; a washing vat mounted within the sealed chamber at about midposition between the top and bottom walls thereof, said washing vat being set forwardly from the rear wall, thus forming an open passage from the top of said sealed chamber to the bottom thereof around the rear of said washing vat, the ends of said washing vat being joined with the side walls of said sealed chamber; a rectangular cross plate disposed horizontally under the washing vat and above the bottom wall of the sealed chamber, with the edges of said cross plate joined to the upright walls, thus forming a dump tank compartment within said sealed chamber, the bottom and sides of said dump tank compartment being formed by the bottom and side walls aforesaid of the sealed chamber; and horizontal and vertical partition means disposed under the washing vat but above the rectangular cross plate, thereby forming air compartment means adapted to house air and vapor cooling means.

6. A cabinet for a dry cleaning machine comprising, in combination: spaced upright side walls, front and rear, top and bottom walls, all integrally joined along their meeting edges and forming therewith a washing and drying chamber of substantially rectangular shape which is adapted to be sealed from atmosphere; a cylindrical washing vat mounted horizontally within the sealed chamber, the ends of said washing vat being joined with the side walls of said sealed chamber; a cross plate disposed horizontally under the washing vat above the bottom wall of the sealed chamber, with the edges of said cross plate joined to the upright walls, thus forming a dump tank compartment within said sealed chamber, the bottom and sides of said dump tank compartment being formed by the bottom and side walls aforesaid of the sealed chamber; and horizontal and vertical partition means disposed under the washing vat above the cross plate and so arranged as to provide a pair of spaced air compartments adapted to house air heating means, and also providing a condenser compartment between said air compartments adapted to house air and vapor cooling means; and an air passage provided at the front of the condenser compartment and leading laterally to each air compartment.

9. A cabinet for a dry cleaning machine comprising, in combination: spaced upright side walls, front and rear walls, with top and bottom walls, all integrally joined along their meeting edges and forming a washing and drying chamber of substantially rectangular shape which is adapted to be sealed from atmosphere; a cylindrical washing vat mounted horizontally within the
sealed chamber between the top and bottom walls thereof, said washing vat being set forwardly from the rear wall, thus forming an open passage from the top of said sealed chamber to the bottom thereof around the rear of said washing vat, a filter chamber being provided in the form of the washing vat, a frame mounted in the filter chamber and having means to retain air filtering means, a door provided in the front wall adjacent the frame and adapted to afford access to said frame; a horizontal partition mounted under the washing vat but above the bottom wall of the sealed chamber, with its edges joined to the upright walls, thus forming a dump tank within said sealed chamber; and horizontal and vertical partition means under the washing vat but above the first partition, thereby forming air compartment means adapted to house air heating means, and also forming condensing compartment means adapted to house air and vapor cooling means.

10. A unitary cabinet construction for a completely closed cleaning machine; comprising spaced upright side walls, front and rear walls, with top and bottom walls, all integrally joined along their meeting edges, and forming therewithin a sealed washing and drying chamber of substantially rectangular form in cross section; a cylindrical washing vat mounted horizontally within the chamber at a midposition between the top and bottom walls of the cabinet and set forwardly from the rear wall, thus forming an open passage from the top of the chamber to the bottom thereof around the rear wall of the vat, with its ends integrally joined with the sides of the cabinet, one end of said vat being closed by one side wall of the cabinet, and the other end of said vat being open through the other side wall; and horizontal and vertical partition walls under the washing vat, forming an air chamber adapted to receive a heater, an air chamber adapted to receive a cooler, and a sump tank.

11. A unitary cabinet construction for a completely closed cleaning machine; comprising spaced upright side walls, front and rear walls, with top and bottom walls, all integrally joined along their meeting edges, and forming therewithin a sealed washing and drying chamber of substantially rectangular form; a cylindrical washing-liquid vat mounted horizontally within the chamber at a midposition between the top and bottom walls of the cabinet and set forwardly from the rear wall, thus forming an open passage from the top of the chamber to the bottom thereof around the rear wall of the vat, with its ends integrally joined with the sides of the cabinet, one end of said vat being closed by one side wall of the cabinet, and the other end of said vat being open through the other side wall; and horizontal and vertical partitions disposed between the cover of the sump tank and the horizontal partition thereby forming a central condenser chamber and a heater box at each side of said condenser chamber, each of the heater boxes being open at a vertical opening through the horizontally disposed partition which connects the passageway aforesaid with the condenser chamber, and a valve seat formed in the condenser chamber, said valve seat opening into a passage which leads to each heater box.

14. A cabinet for dry cleaning machines, comprising an upright chamber, containing a washing vat, a part of which arches forwardly beyond the front vertical wall of the cabinet; a filter supporting means in the chamber above the vat, with a door plate mounted on the chamber and normally sealed to close an opening leading to the filter supporting means; the vat having vent openings adjacent and in front of the filter supporting means, an air and vapor passage leading to the chamber above the vat, and a cover plate mounted on the rear side of the chamber above the vat and opening into the rear of a recovery-condenser compartment; a vertical wall forming the front of the condenser compartment, spaced back from the front of the cabinet, thereby forming a lateral passage in front of the walls, all integrally joined along their meeting edges, and forming therewithin a sealed washing and drying chamber
condenser compartment into which extends each end of said lateral passage.

15. A cabinet for dry cleaning machines, comprising an upright chamber, containing a washing vat, a part of which arches forwardly beyond the front vertical wall of the cabinet; a filter supporting means in the chamber above the vat, with a door plate mounted on the chamber and normally sealed to close an opening leading to the filter supporting means; the vat having vent openings adjacent and in front of the filter supporting means, an air and vapor passage leading downwardly from the filter supporting means behind the vat and opening into the rear of a recovery-condenser compartment; a vertical wall forming the front of the condenser compartment, spaced back from the front of the cabinet, thereby forming a lateral passage in front of said condenser compartment, an air-heater compartment at each side of said condenser compartment into which extends each end of said lateral passage; and a large block-off port formed in the vertical wall at the front of the condenser compartment and opening into the lateral passage afforded, an air inlet port formed in the front vertical wall of the cabinet in alignment with the block-off port and likewise opening into said lateral passage, said two ports being spaced apart to accommodate a single valve head therebetween.

16. A cabinet for dry cleaning machines, comprising an upright chamber, containing a washing vat, a filter supporting means in the chamber above the vat, with a door plate mounted on the chamber and normally sealed to close an opening leading to the filter supporting means; the vat having vent openings adjacent and in front of the filter supporting means, an air and vapor passage leading downwardly from the filter supporting means behind the vat and opening into the rear of a recovery-condenser compartment; a vertical wall having an opening therethrough, an air-heater compartment at each side of said condenser compartment into which extends each end of said lateral passage; a drain channel formed in the bottom of the vat and extending from end to end thereof; and the bottom of the condenser compartment being pitched from the air-heater compartments.

17. A cabinet for dry cleaning machines, comprising a work-treating chamber, a cylindrical vat mounted horizontally within the chamber, a plate set upright above the vat and having its lower edge joined to said vat and its upper edge joined to the top wall of the chamber with the plate ends joined to the chamber sides, openings provided in said plate adapted to receive filter bag means, openings provided in the vat in front of the upright plate, an opening in the chamber in front of the upright plate affording access to the chamber, by which to insert and remove the filter bag means, and a removable cover plate sealed down over the last named opening.

18. A cabinet for dry cleaning machines, comprising a chamber, a vat mounted in the chamber, an opening for a door at the front of the chamber leading into the vat, the upper part of the vat and a pair of spaced baffle plates extending from said vat into the upper part of said chamber; a pair of spaced baffle plates extending in front of the openings, and the other at the rear of said openings, and both of said baffle plates with the series of openings therebetween being located proximate the upper edge of the aforesaid opening for the door.

19. A cabinet for dry cleaning machines, comprising a chamber, a vat mounted in the chamber, an opening for a door at the front of the chamber leading into the vat, the upper part of the vat being provided with a series of openings leading from said vat into the upper part of said chamber; a dump tank occupying the bottom part of the chamber and extending from end to end and from front to back thereof; a recovery-condenser compartment provided above the dump tank, located centrally of the chamber and extending from the rear wall toward the front wall but not to the latter, thus forming a lateral passage at the front of said chamber in communication with said recovery condenser compartment; a passage extending downwardly behind the vat and communicating with the recovery condenser compartment through an opening formed through the latter at the rear top part thereof; and an air-heating compartment adjacent each side of the condenser compartment, with the lateral passage opening into each air-heating compartment.

20. A cabinet for dry cleaning machines, comprising a work-treating chamber containing a plurality of compartments and passages, such as a washing vat having vent openings, an air and vapor passage leading from the vent openings, filter supporting frame means in the air and vapor passage, a recovery-condenser compartment connected at one end with the passage, an air and vapor passage leading from the other end of the condenser compartment, an air-heating compartment into which the air passage leads, and a dump tank compartment, all of which are intervented into each other to permit a transfer of air and vapor pressure from one chamber portion to another, the chamber being sealed from atmosphere.

21. A cabinet for dry cleaning machines, comprising a work-treating chamber containing a plurality of compartments and passages, such as a washing vat having vent openings, an air and vapor passage leading from the vent openings, filter supporting frame means in the air and vapor passage, a recovery-condenser compartment connected at one end with the passage, an air passage leading from the other end of the condenser compartment, an air-heating compartment into which the air passage leads, a dump tank compartment, all of which are intervented into each other to permit a transfer of air and vapor pressure from one chamber portion to another, the cabi

22. A dry cleaning machine comprising, in combination, a cabinet, including a walled construction forming an enclosed work-treating chamber sealed from the atmosphere, a solvent storage tank mounted behind the chamber, a solvent vat mounted within the sealed chamber below the storage tank, a pair of spaced baffle plates extending from the storage tank to the vat, a perforated washing drum rotatably mounted in the vat, an air and vapor filter compartment within the sealed chamber.
above and in communication with the vat and

drum, a solvent-recovery condenser within the
sealed chamber under the vat, an air and vapor
duct within the sealed chamber and serving to
connect the filter compartment with the solvent-
recovery condenser; two air heating compart-
ments within the sealed chamber, one on each
side of and adjacent the solvent-recovery con-
denser and connected with the latter; a conduit
on each side of the cabinet and chamber con-
necting each air heating compartment with the
drum, and a blower in each conduit to blow the air and
vapor from the perforated washing drum and
circle it through the recovery condenser and
both air heating compartments.

23. A dry cleaning machine comprising, in com-
bination, a walled construction forming an en-
closed work-treating chamber sealed from the
atmosphere, a solvent vat mounted within the
sealed chamber and having perforations in its
upper portion, a solvent storage tank mounted
below in the drum above the vat, a valve con-
nection from the storage tank to the vat, a pump
tank under the vat, a valve connection from the
vat to the pump tank, a perforated washing drum
rotatably mounted in the perforated vat, an air
and vapor filter compartment within the sealed
chamber above and in communication with the
solvent-recovery condenser, an air heating compart-
ment with the solvent-recovery condenser
adjacent each side of the centrally disposed
recovery condenser aforesaid; and in
communication with the latter, an air
conduit connecting each air heating compartment
with an air inlet at the end of the vat; a blower in
each conduit having filter means to blow air and
vapor from the perforated washing drum out through
the apertured vat, through the filter compartment,
and down the air and vapor duct to circulate it
through the chamber solvent filter compartment
within the sealed chamber above and in communica-
tion with the aperture, a solvent-recovery condenser
disposed centrally within the sealed chamber under
the vat, an air and vapor duct within the sealed
chamber and serving to connect the filter compo-
25. A dry cleaning machine comprising, in
combination, an enclosed work-treating chamber
sealed from the atmosphere, a solvent vat fixed
within the sealed chamber and provided with
venting apertures in its upper portion and an air
inlet at each end thereof, a perforated washing
drum rotatably mounted in the vat and also hav-
ing an air inlet at each end to receive the air
entering from the ends of the vat, an air and
compartment with the solvent-recovery condenser;
air heating compartments within the sealed
chamber, one adjacent each side of the centrally
disposed recovery condenser aforesaid, and
in communication with the latter; an air conduit
connecting each air heating compartment with
an air inlet at the end of the vat; and a blower
in each conduit to blow the air and vapor from
the perforated washing drum out through
the apertured vat, through the filter compartment,
and down the air and vapor duct to circulate it
through the chamber solvent filter compartment
within the sealed chamber above and in communica-
tion with the aperture, a solvent-recovery condenser
disposed centrally within the sealed chamber under
the vat, an air and vapor duct within the sealed
chamber and serving to connect the filter compo-
26. A dry cleaning machine comprising, in
combination, a walled construction forming an
enclosed work-treating chamber sealed from the
atmosphere, a cylindrical solvent vat fixed from
horizontally within the sealed chamber, a perforated
washing cylinder rotatably mounted in the fixed
vat, an air and vapor filter compartment within
the sealed chamber above and in communication
with the valve connection aforesaid, by which the vat breathes back into
the storage tank and the pump tank breathes back
to the vat.

24. A dry cleaning machine comprising, in com-
bination, an enclosed work-treating chamber
sealed from the atmosphere, a solvent vat fixed
within the sealed chamber and provided with
venting apertures in its upper portion and an air
inlet at each end thereof, a perforated washing
drum rotatably mounted in the vat and also hav-
ing an air inlet at each end to receive the air
entering from the ends of the vat, an air and
compartment with the solvent-recovery condenser;
air heating compartments within the sealed
chamber, one adjacent each side of the centrally
disposed recovery condenser aforesaid, and
in communication with the latter; an air conduit
connecting each air heating compartment with
an air inlet at the end of the vat; and a blower
denser within the sealed chamber under the vat, an air and vapor duct within the sealed chamber and connecting the filter compartment with the recovery condenser, air heating compartment means within the sealed chamber adjacent and in communication with the recovery condenser, conduit means connecting the air heating compartment means with each end of the perforated rotatable washing drum, and blower fans in the conduit means to force heated air through the perforated rotatable washing drum and circulate it through the sealed chamber to cool the air and recover the solvent and to reheat the air and vaporize the solvent.

28. A washing machine comprising, in combination, a sealed work-treating chamber, a stationary washing vat within the chamber having an air inlet at each end thereof and air outlets at the top thereof, a rotatable washing drum within the vat also having an air inlet at each end thereof and air outlets circumferentially thereof, air-transfer means provided between both of the adjacent vat and drum ends to guide and transfer the air from the stationary vat ends into the rotatable washing drum ends, an air heating box under each end of the washing vat, an air conduit extending upwardly from each air heating box and connected with the respective air-transfer means thereabove, a motor driven blower included in each conduit to force air into each end of the rotatable washing drum and out through the air outlets of said drum and said vat, and a passage to convey the air back to the air heating boxes.

29. A washing machine comprising, in combination, a sealed work-treating chamber, a stationary washing vat inside the sealed chamber having an air inlet at each end thereof and air outlets at the top thereof, a rotatable washing drum inside the vat also having an air inlet at each end thereof and air outlets circumferentially thereof; interfitting relatively rotatable ring means into said rotatable washing drum projecting into the vat, with a flanged air-receiving pocket carried on each end of the rotatable drum and fitting over the projecting ring, both of which are between the adjacent vat and drum ends to guide and transfer the air from the stationary washing drum ends; an air heating box adjacent each end of the vat, an air conduit extending from each air heating box and connected with the respective rotatable ring means, a motor driven blower included in each conduit to force air into each end of the rotatable washing drum and out through the air outlets of said drum and vat, and a passage to convey the air back to the air heating boxes in a continuous circuit through the sealed chamber.

30. A washing machine comprising, in combination, a sealed work-treating chamber, a stationary washing vat inside the sealed chamber having an air inlet thereinto and air outlets at the top thereof, a rotatable washing drum inside the vat also having an air inlet thereinto and air outlets circumferentially thereof; interfitting relatively rotatable ring means, comprising a stationary ring projecting into the vat, with a flanged air-receiving pocket carried on the rotatable drum and fitting over the projecting ring, both of which are between the adjacent vat and drum ends to guide and transfer the air from the stationary vat end into the rotatable drum end; an air heating compartment, a passage connecting the air outlets of the washing vat with the air heating compartment, a conduit carried on the wall outside the sealed chamber and interconnecting the air heating compartment with the air inlet of the washing vat, and a motor mounted on the wall outside the chamber for driving a blower included in the conduit to circulate the air through the washing drum.

31. A washing machine comprising, in combination, a sealed work-treating chamber formed within a wall construction, a stationary washing vat within the chamber having an air inlet at each end thereof and air outlets at the top thereof, a rotatable washing drum within the vat also having an air inlet at each end thereof and air outlets circumferentially thereof, two rotatable flanged rings means telescopically operating one within the other provided between both of the adjacent vat and drum ends to guide and transfer the air from the stationary vat ends into the rotatable drum ends, an air heating box within the sealed chamber adjacent each end of the vat, an air conduit extending from each heating box and connecting with the respective air inlet at each end of the washing vat, and a motor driven blower included in each conduit to force air into each end of the rotatable drum and out through the air outlets of said drum and vat.

32. A washing machine comprising, in combination, a sealed work-treating chamber formed within a welded wall construction, a stationary washing vat inside the chamber having an air inlet at each end thereof, a rotatable washing drum in the vat also having an air inlet at each end thereof and air outlets circumferentially thereof, air-transfer means provided between both of the adjacent vat and drum ends to guide and transfer the air from the stationary vat ends into the rotatable drum ends; an air heating box under each end of the vat, thus providing two heating boxes spaced apart within the sealed chamber, with an air passage between said heating boxes; an air conduit extending from each heating box and connecting with the air inlet respectively at each end of the vat, a motor driven blower included in each conduit and attached to the wall outside the sealed chamber to force air into each end of the rotatable drum and out through the air outlets of said drum, and means including a passage to take the air out of the vat and convey said air back to the heater boxes through the air passage between the two heating boxes aforesaid.

33. A washing machine comprising, in combination, a sealed work-treating chamber, a stationary washing vat in the chamber having an air inlet at each end thereof and air outlets at the top thereof, a rotatable washing drum carried on a shaft journaled in the vat and having an air inlet at each end thereof proximate to the shaft and also having air outlets circumferentially thereof, air-transfer means concentric with the shaft at each end of the vat to convey the air from each inlet thereof into each end of the rotatable washing drum, an air heating box for each end of the vat, an air heating compartment, a passage connecting the air outlets of the washing vat with the air heating compartment, a conduit carried on the wall out-
walls, and a perforated washing drum rotatably mounted in said vat; a dump tank within the sealed chamber directly under and spaced below the vat and formed by the walls aforesaid, recovery condenser and air heating compartments occupying the space between the vat and dump tank, a drain channel formed in the bottom of the vat and adapted to drain solvent to one end thereof, a valve housing containing a dump valve attached to the wall outside the sealed chamber and into which the drain channel empties; an elongated button trap housing attached uprightly to the wall outside the sealed chamber, with its upper end connected with the valve housing, and extending along the wall downwardly beyond the compartments aforesaid within the sealed chamber, and its lower end attached by a clean-out connection with the dump tank; and air passage and blower means effecting a circulation of air within the sealed chamber through the recovery condenser and heating compartments on a continuous circuit through the perforated washing drum.

35. A dry cleaning machine comprising, in combination, walls forming a sealed washing and drying chamber enclosing a horizontal washing vat having perforations from end to end along its upper portion, the ends of the vat being carried between said chamber walls, one end of the vat being closed by one wall, the other end having an opening of the size of the vat, a cover cap over said opening, a perforated washing drum rotatably mounted in said perforated vat, solvent recovery condenser and air heating means within said closed chamber, the plurality of porous filter bags carried in a frame mounted above the vat perforations, said bags projecting rearwardly into an air and vapor duct leading downwardly at the rear of the sealed chamber, and blower means in circuit with said duct effecting a continuous flow of air within the sealed chamber through the solvent recovery condenser and the air heating means and through the perforated washing drum and the porous filter bags.

36. A dry cleaning machine comprising, in combination, walls forming a sealed washing and drying chamber enclosing a horizontal washing vat having perforations from end to end along its upper portion, the ends of the vat being carried between said chamber walls, a perforated washing drum rotatably mounted in said perforated vat, solvent recovery condenser and air heating means within said closed chamber, a plurality of filter bags carried in a frame mounted above the vat perforations and extending from end to end of the vat, an inspection opening and cover plate provided on the wall of the sealed chamber in front of and adjacent to the filter bags to make said bags accessible for cleaning and replacement, said bags projecting horizontally rearwardly into an air and vapor duct leading downwardly at the rear of the sealed chamber, and blower means in circuit with said duct effecting a continuous flow of air within the sealed chamber through the recovery condenser and the air heating means and through both ends of the perforated washing drum outwardly through the vat perforations and the filter bags back down the duct.

37. A dry cleaning machine comprising, in combination, walls forming a sealed washing and drying chamber enclosing a horizontal washing vat containing a washing drum rotatably mounted in said vat; a dump tank within the sealed chamber directly under and spaced below the vat and formed by the walls aforesaid, a recovery condenser compartment occupying the central space between the vat and dump tank, an air heating box at each side of and on the same level with the recovery condenser, a valve housing containing a dump valve attached to the wall outside the sealed chamber and connected with the vat; an elongated button trap housing attached uprightly to the wall outside the sealed chamber, with its upper end connected with the valve housing, and extending along the wall downwardly beyond the heating box, and its lower end connected with the dump tank; and air passage and blower means effecting a circulation of air within the sealed chamber through the recovery condenser and heating compartments on a continuous circuit through the perforated washing drum.

38. A dry cleaning machine comprising, in combination, walls forming a sealed washing and drying chamber enclosing a horizontal washing vat having perforations from end to end along its upper portion, the ends of the vat being carried between said chamber walls, a perforated washing drum rotatably mounted in said perforated vat, solvent recovery condenser and air heating means within said closed chamber, the plurality of porous filter bags carried in a frame mounted above the vat perforations, said bags projecting rearwardly into an air and vapor duct leading downwardly at the rear of the sealed chamber, and blower means in circuit with said duct effecting a continuous flow of air within the sealed chamber through the solvent recovery condenser and the air heating means and through the perforated washing drum and the porous filter bags.

39. A dry cleaning machine comprising, in combination, walls forming a sealed washing and drying chamber enclosing a horizontal washing vat having perforations from end to end along its upper portion, the ends of the vat being carried between said chamber walls, a perforated washing drum rotatably mounted in said perforated vat, solvent recovery condenser and air heating means within said closed chamber, a plurality of filter bags carried in a frame mounted above the vat perforations and extending from end to end of the vat, an inspection opening and cover plate provided on the wall of the sealed chamber in front of and adjacent to the filter bags to make said bags accessible for cleaning and replacement, said bags projecting horizontally rearwardly into an air and vapor duct leading downwardly at the rear of the sealed chamber, and blower means in circuit with said duct effecting a continuous flow of air within the sealed chamber through the recovery condenser and the air heating means and through both ends of the perforated washing drum outwardly through the vat perforations and the filter bags back down the duct.

40. A dry cleaning machine comprising, in combination, walls forming a sealed washing and drying chamber enclosing a horizontal washing vat the ends of which are carried between said walls, and a perforated washing drum rotatably mounted in said vat; a dump tank within the sealed chamber directly under and spaced below the vat and formed by the walls aforesaid, a recovery condenser compartment occupying the central space between the vat and dump tank, an air heating box at each side of and on the same level with the recovery condenser, a valve housing containing a dump valve attached to the wall outside the sealed chamber and connected with the vat; an elongated button trap housing attached uprightly to the wall outside the sealed chamber, with its upper end connected with the valve housing, and extending along the wall downwardly beyond the heating box, and its lower end connected with the dump tank; and air passage and blower means effecting a circulation of air within the sealed chamber through the recovery condenser and heating compartments on a continuous circuit through the perforated washing drum.
machine is deodorizing the work in the washing drum.

40. A washing machine comprising, in combination, a sealed work-treating chamber enclosing a liquid vat, a washing drum on a shaft journaled in the vat, carrying the sealed chamber in which the shaft rotates, means for sealing the bearings against the leaking of liquid along the shaft to the outside of the sealed chamber, a liquid-receiving cavity in the bearing outside the chamber which receives such liquid as passes the bearings, a tube extending from the cavity downwardly to the inside of the sealed chamber to provide a gravity return of the liquid back into the machine, and liquid-locking means associated with the tube to allow the liquid to pass back into the machine by gravity flow and to prevent liquid or vapor from breaching outwardly toward the bearing to atmosphere.

41. A washing machine comprising, in combination, a sealed work-treating chamber enclosing a liquid vat, a washing drum on a shaft journaled in the vat, bearing means with a stuffing box carrying the chamber, a return tube mounted outside the chamber and connected with the bearing means and extending downwardly with its lower end directed into the chamber to afford a gravity return back into said chamber of the liquid which has returned from the stuffing box, a tube in the chamber to permit a flow of liquid downwardly therethrough but to check and prevent the sealed chamber from breathing outwardly therethrough, and a sight indicator in the tube to show the flow of liquid down the tube as evidence of the condition of the stuffing box.

42. A dry cleaning machine comprising, in combination, an upright work-treating chamber closed from atmosphere, a solvent vat and washing drum journaled on bearing means within the closed chamber, a passage formed in the closed chamber and communicating with the upper portion of the vat to receive air and vapor therefrom, said passage extending downwardly behind the vat, air filtering means in the upper part of the passage, a condenser compartment under the vat and the lower end of the passage adjacent opening into the rear portion thereof, an air heating compartment also under the vat, the top and bottom of the compartment being formed by horizontally disposed plates common to both compartments, heating coils in the air heating compartment, refrigerating means within the condenser compartment, a passage in the front part of the closed chamber connecting the front of the condenser compartment with the air heating compartment, conduit and blower means connecting the air heating compartment with the washing drum, a storage tank to supply solvent to the vat and washing drum, a dump tank to receive the soiled solvent after its use in the vat; means to seal the closed chamber during normal operation, to return solvent into the chamber which may leak through the stuffing box and to interconnect all tanks and compartments and passages with each other and with the closed and sealed chamber, whereby all internal parts of the machine may breathe back and forth into each other during the flow of solvent and during the operation of the heating and refrigerating coils.

43. A dry cleaning machine and solvent system combined therewith, comprising an upright chamber sealed from the atmosphere; a solvent vat in the upper part of the chamber containing a perforated drum which washes, dries and extracts the work; a solvent recovery condenser, and air heating means in the lower part of the chamber under the vat; an air and vapor duct formed in the chamber communicating the upper part of the vat with the recovery condenser, air and vapor filter means in the duct, an air passage formed in the chamber communicating the recovery condenser with the air and vapor filter means, an air conduit and blower means connecting the air heating means with the washing drum to blow air therethrough and drive the solvent vapor therefrom into the duct, a storage tank above the vat and a valve passage leading therefrom down into said vat, a dump tank between the vat and a valve passage connecting said vat with said dump tank; and a solvent-clarifying system adjacent the sealed chamber, including a still, a still condenser mounted above the still with a connecting flue therebetween, said still condenser being located above the storage tank, piping having a pump connecting the dump tank with the still to force soiled solvent from said dump tank into said still, piping connecting the still condenser with the storage tank adapted to deliver distilled solvent from said storage tank; and intervening connections from the still condenser to the storage tank, piping having a pump connecting the dump tank with the still to force soiled solvent from said dump tank into said still, piping connecting the still condenser with the storage tank adapted to deliver distilled solvent from said storage tank; and intervening connections from the still condenser to the storage tank, piping having a pump connecting the dump tank with the still to force soiled solvent from said dump tank into said still, piping connecting the still condenser with the storage tank adapted to deliver distilled solvent from said storage tank; and intervening connections from the still condenser to the storage tank.
age tank, to the sealed chamber, and to the dump tank, whereby the sealed chamber and the solvent-clarifying system interbreath back and forth into each other during either the separate or combined action of the recovery condenser, the still condenser, and/or the air heating means, and also during the flow of solvent from one part of the machine to another either in the sealed chamber or in the solvent-clarifying system.

45. A dry cleaning machine and solvent system combined therewith, comprising an upright chamber sealed from the atmosphere; a solvent recovery condenser, a water separator connected therewith, and a vessel to receive condensate from the sealed chamber, a closed water receiver connected with the vessel, and an interceptor connecting the closed water receiver with the sealed chamber; air heating means in the lower part of the chamber under the vat; an air and vapor duct formed in the chamber communicating the upper part of the chamber with the recovery condenser, air and vapor filter means in the duct, an air passage formed in the chamber communicating the recovery condenser with the air heating means, an air conduit and blower means connecting the air heating means with the washing drum to blow air therethrough and drive the solvent vapor therefrom into the duct, a storage tank above the vat and a valve passage leading therefrom down into said vat, a dump tank below the vat and a valve passage connecting said vat with said dump tank; and a solvent-clarifying system adjacent the sealed chamber, including a still, a still condenser mounted above the still with a connecting flue therebetween, said still condenser being located above the storage tank, piping having a pump connecting the still to said condenser being located above the storage tank, piping having a pump connecting the still to said condenser; a closed water receiver connected with a solvent cooler at a point below the still condenser and above the storage tank; and intervening connections from the still condenser to the last named water receiver, to the storage tank, to the sealed chamber, and to the dump tank, whereby the sealed chamber and the solvent-clarifying system interbreath back and forth into each other during either the separate or combined action of the recovery condenser, the still condenser, and/or the air heating means, and also during the flow of solvent and/or separated water from one part of the machine to another either in the sealed chamber or in the solvent-clarifying system.

46. The combination specified in the foregoing claim, but characterized by providing a solvent recovery condenser and water separator, designated as a recovery-condenser water-separator, comprising a vessel connected with the recovery condenser to receive the condensate cooled in said condenser, which condensate separates into free water and solvent; a pipe connecting the top of the vessel with the dump tank to convey the solvent thereinto by gravity, a pipe connecting the top of the vessel at a point above the solvent level with a water receiver sealed from atmosphere and located above the solvent level, the water overflows thereinto, and an interceptor connecting the sealed water receiver to the sealed chamber.

47. A dry cleaning machine and solvent system combined therewith, comprising an upright chamber sealed from the atmosphere; a solvent vat in the upper part of the chamber containing a perforated drum which washes, dries and extracts the work; a solvent recovery condenser, a water separator connected therewith, and a vessel to receive condensate from said condenser; a closed water receiver connected with the vessel, and an interceptor connecting the closed water receiver with the sealed chamber; air heating means in the lower part of the chamber under the vat; an air and vapor duct formed in the chamber communicating the upper part of the vat with the recovery condenser, air and vapor filter means in the duct, an air passage formed in the chamber communicating the recovery condenser with the air heating means, an air conduit and blower means connecting the air heating means with the washing drum to blow air therethrough and drive the solvent vapor therefrom into the duct, a storage tank above the vat and a valve passage leading therefrom down into said vat, a dump tank below the vat and a valve passage connecting said vat with said dump tank; and a solvent-clarifying system adjacent the sealed chamber, including a still, a still condenser mounted above the still with a connections to the still condenser with the storage tank adapted to deliver distilled solvent by gravity to said storage tank, an intercooler included in said gravity flow piping to receive and chill the distilled solvent, separator the water therefrom to purify said solvent and a water draw-off vessel sealed from the atmosphere and connected with the top of the intercooler to catch the separated water; and intervening connections from the still condenser to the storage tank, to the sealed chamber, to the intercooler, and to the dump tank, whereby the sealed chamber and the solvent-clarifying system interbreath back and forth into each other during either the separate or combined action of the recovery condenser, the still condenser, and/or the air heating means, and also during the flow of solvent and/or separated water from one part of the machine to another either in the sealed chamber or in the solvent-clarifying system.
a water pipe interconnected between the coils in the still condenser and the cylinder to open said control valve by water pressure flowing through said coils; piping having a pump connecting the dump tank with the still to force soiled solvent from said dump tank into said still, piping connecting the still condenser with the storage tank adapted to deliver distilled solvent by gravity to said storage tank; and intervening connections from the still condenser to the storage tank, to the sealed chamber, and to the dump tank, and a normally-closed safety valve in the intervening connections, whereby the sealed chamber and the sealed solvent-clarifying system interbreath back and forth into each other during either the separate or combined action of the recovery condenser, the still condenser, the still, and/or the air heating means, and also during the flow of solvent from one part of the machine to another either in the sealed chamber or in the sealed solvent-clarifying system, and whereby the steam to the still is ordinarily shut off by the control valve aforesaid when the still condenser stops, but if the control valve leaks abnormally the safety valve will open to vent the chamber and system to atmosphere.

49. A dry cleaning machine and solvent distilling system comprising, in combination, a sealed chamber having a solvent vat and washing drum, a solvent recovery condenser connected with the vat, cold water coils in the recovery condenser adapted to receive a uniformly constant supply of water flowing therethrough, a still condenser with cold water coils therein also adapted to receive and operate on a uniformly constant flow of cold water therethrough, a still and a steam pipe connected therewith, said still being connected with the still condenser, and a normally-closed steam cut-off valve in the steam pipe, means operated automatically by the uniformly constant flow of cold water aforesaid to open and hold open the steam cut-off valve; thereby interlocking the cold water flow with the steam flow, and thus the distilling and condensing actions are conjoint and are off and on together; a solvent-flow connection between the still condenser and the vat, and from the vat back to the still; and interbreather connections between the sealed chamber, the vat, the recovery condenser, the still, and the still condenser, whereby pressure equalization takes place throughout the machine and system; the capacity of the still condenser being sufficient to condense as fast as the still vaporizes, which precludes rise of vapor pressure in the system, coupled with the pressure equalization and with the interlocked water and steam flow aforesaid, insures the internal operation of the sealed machine and system at a normally constant pressure proximate atmospheric pressure which reduces to a minimum the tendency for atmospheric breathing.

50. A dry cleaning machine comprising, in combination, a work-treating chamber sealed by a view door and a transferring vat adapted to receive solvent, a washing receptacle in the vat, a recovery condenser within the chamber, a duct communicating the receptacle and vat with the condenser, air-heating means within the chamber, a passageway extending the condenser with the air-heating means, conduit and blower means communicating the air-heating means with the receptacle, thereby providing continuous air circulation thru the receptacle and condenser, to recover the solvent from the work in the receptacle; a dump tank within the chamber under the condenser, a dump connection leading from the vat down to the dump tank and having a dump valve therein, a drain connection from the recovery condenser to the dump tank; a storage tank sealed from the atmosphere, an inlet valve connected with the storage tank to the vat, a pipe line from the dump tank to the storage tank, a solvent-clarifying filter in the pipe line, a pump in the pipe line; an intervening connection placing the storage tank in breathing relation with the sealed chamber, and an intervening connection also placing the dump tank in breathing relation with the sealed chamber, whereby the solvent will flow freely to and from the storage tank and dump tank, and whereby the sealed chamber has a storing capacity to retain the solvent vapor until all thereof is reduced by the condenser.

51. A dry cleaning machine and solvent system combined therewith; comprising a solvent vat sealed from the atmosphere, and in which is operatively mounted a perforated washing drum which washes, dries and extracts the wash, a sealed solvent-recovery condenser, and a sealed air heating means, an air and vapor duct communicating the upper part of the vat with the recovery condenser, an air and vapor filter means in the duct, an air passage communicating the recovery condenser with the air heating means, an air conduit and blower means connecting the air heating means with the washing drum to blow air therethrough and drive the solvent vapor therefrom into the duct, a sealed storage tank above the vat and a valved passage leading therethrough down into said vat, a sealed dump tank below the vat and a valved passage connecting said vat with said dump tank, a drain connection from the recovery condenser to the dump tank; and a sealed solvent-clarifying system including a still, a still condenser mounted above the still with a connecting flue therebetween, said still condenser being located above the storage tank, piping having a pump connecting the dump tank with the still to force soiled solvent from said dump tank into said still, piping connecting the still condenser with the storage tank adapted to deliver distilled solvent by gravity to said storage tank; and intervening-connection means connecting the still condenser with the storage tank, with the sealed vat, and with the dump tank, whereby the vat and the solvent-clarifying system are both sealed from atmosphere under normal operating conditions and interbreath back and forth into each other during either the separate or combined action of the recovery condenser, the still condenser, and/or the air heating means, as well as during the flow of solvent in the machine or system.

52. A dry cleaning machine and a solvent system combined therewith; comprising a solvent vat sealed from the atmosphere, and containing a drum which washes, dries and extracts the solvent from the work; a sealed solvent recovery condenser, and air and vapor washing vat adapted to receive solvent, a washing receptacle in the vat, a recovery condenser within the chamber, a duct communicating the receptacle and vat with the condenser, air-heating means within the chamber, a passageway extending the condenser with the air-heating means, conduit and blower means connecting the air-heating means with the receptacle, thereby providing continuous air circulation thru the receptacle and condenser, to recover the solvent from the work in the receptacle; a dump tank
said vat with said dump tank; and a sealed solvent-clarifying system including a still, a still condenser mounted above the still with a connecting flue therebetween, said still condenser being located above the storage tank, solvent piping having a pump connecting the dump tank with the still to force solidded solvent from said dump tank into said still, a valve in said solvent piping, a by-pass piping having a solvent filter connected ahead of the pump with the solvent piping and also connected with the storage tank, also a valve in the by-pass piping, one or the other valves being optionally closed whereby to pump the solidded solvent either to the still or to the storage tank, piping connecting the still condenser with the storage tank adapted to deliver distilled solvent by gravity to said storage tank; and interventing connections from the still condenser to the storage tank, to the sealed vat, and to the dump tank, whereby the vat and the solvent-clarifying system interbreath back and forth into each other during either the separate or combined action of the recovery condenser, the still condenser, and/or the air heating means, said condenser also during the transfer of solvent from one part of the machine to another part thereof or to and from the solvent-clarifying system.

53. A dry cleaning machine and a solvent system combined therewith; comprising a solvent washing vat sealed from the atmosphere, and containing a perforated drum which washes, dries and extracts the work; a solvent recovery condenser, and an air heating means, both sealed from the atmosphere; an air and vapor duct communicatin the upper part of the vat with the recovery condenser, an air and vapor filter means in the duct, an air passage communicating the recovery condenser with the air heating means, an air conduit and blower means connecting the air heating means with the washing receptacle to blow air therethrough and drive the solvent vapor therefrom into the duct, a sealed storage tank above the vat and a valve passage leading therefrom down into said vat, a sealed dump tank below the vat and a valve passage connecting said vat with said dump tank; and a sealed solvent-clarifying system, including a still, a still condenser mounted above the still with a connecting flue therebetween, said still condenser being located above the storage tank, piping having a pump connecting the dump tank with the still to force solidded solvent from said dump tank into said still; piping including a sealed solvent cooler connecting the still condenser with the storage tank adapted to deliver distilled and purified solvent by gravity to said storage tank, a sealed water receiver connected with solidded cooler at a point below the still condenser and above the storage tank; interventing connections from the still condenser to the last named water receiver, to the storage tank, to the vat, and to the dump tank, whereby interbreathing occurs during either the separate or combined action of the recovery condenser, the still condenser, and/or the air heating means, and also during the flow of solvent and/or separated water from one place to another.

56. A dry cleaning machine and solvent system, in combination; comprising a washing vat sealed from the atmosphere, and containing a perforated drum which washes, dries and extracts the work; a solvent recovery condenser, and an air heating means, both sealed from the atmosphere, an air and vapor duct communicating the vat with the recovery condenser, an air and vapor filter means in the duct, an air passage communicating the recovery condenser with the air heating means, an air conduit and blower means connecting the air heating means with the drum to blow air therethrough into the duct, a sealed storage tank above the vat and a valve passage leading therefrom down into said vat, a sealed dump tank below the vat and a valve passage connecting said vat with said dump tank; and a solvent-clarifying system normally sealed from the atmosphere and in circuit with the vat, 5
including a still, a still condenser having cold-water coils mounted above and connected with the still, said still condenser being located above the storage tank, a steam-heating means for heating the still condenser, a still valve connected with the still, and means holding said control valve normally closed, a piston and cylinder means operatively connected with said control valve, and a water pipe inter-connected between the coils in the still condenser and the cylinder to open said control valve by water pressure; flowing cold water through said pump and having a pump connecting the dump tank with the still to force cooled solvent from said dump tank into said still, piping connecting the still condenser with the storage tank and adapted to deliver distilled solvent by gravity to said storage tank; and interventing connections from the still condenser to the storage tank, to the vat, as well as to the dump tank, and a normally-closed safety valve in the interconnecting means adapted to open to atmosphere, whereby the vat and the solvent-clarifying system can inter-breathe back and forth into each other during either the separate or combined operation of the recovery condenser, the still condenser, the still, and/or the air heating means, and also during the flow of solvent from one place to another, and wherein the pressure in the still is ordinarily shut off by the control valve aforesaid when the still condenser stops condensing, but if the control valve leaks the safety valve will open to vent any excess pressure which the still may develop.

67. A dry cleaning machine and solvent distilling system, in combination, comprising a sealed washing vat with a washing drum therein, a sealed recovery condenser connected with the vat, cold water coils in the recovery condenser adapted to receive a uniformly constant supply of water flowing therethrough, a sealed still condenser with water coils therein and also adapted to receive and operate on a uniformly constant flow of cold water therethrough, a still also sealed and having a steam pipe connected therewith, said still being connected with the still condenser, and a normally-closed steam cut-off valve in the steam pipe, means operatively connected with the tank to form a uniformly constant flow of cold water aforesaid to open and hold open the steam cut-off valve; thereby interlocking the cold water flow with the steam flow, by which the still and the condensing actions are made interdependent, and are off and on together; a solvent-flow connection between the still condenser and the vat, and from the vat back to the still; and interbreather connections between the vat, the recovery condenser, the still, and the still condenser, whereby pressure equalization takes place within the machine and its solvent system: the capacity of the still condenser being sufficient to condense as fast as the still vaporizes, which precludes rise of vapor pressure, coupled with the pressure equalization and with the interlocked water and steam flow aforesaid, insures operation at a normally constant internal pressure proximate atmospheric pressure, which eliminates the tendency for formation of hydrogen, and conserves the solvent.

58. A dry cleaning machine comprising, in combination; a work-treating chamber sealed from the atmosphere, and having therein a washing vat adapted to receive solvent, a perforated washing receptacle in the vat for holding the work to be cleaned, a solvent-recovery condenser inside the chamber, an air passage communicating the receptacle and vat with the condenser, air-heating means within the sealed chamber, an air passage communicating the condenser with the air-heating means, air duct and blower means communicating the air-heating means and the air-heating receptacle, thereby providing a circulation of air confined within the sealed chamber and directed through the receptacle to vaporize the solvent in the work and carry the vapors therefrom to the condenser where said vapors are liquefied thus recovering the solvent; a solvent-receiving tank sealed from the atmosphere and arranged under the condenser into which the solvent runs from the vat; means for transferring the solvent from the solvent-receiving tank back to the washing vat and the receptacle therein, including a pipe line, a pump in said pipe line, and a filter means in said pipe line through which the solvent passes and is cleansed thereby; an interventing connection placing the sealed solvent-receiving tank in breathing relation with the sealed chamber and the washing vat therein, whereby the solvent will flow freely in its circuit from said solvent-receiving tank to the washing vat and to the receptacle and then return to said tank without becoming air bound within the sealed machine, and whereby the sealed work-treating chamber acts as a vapor storage to retain the solvent vapor released from the work until all thereof is reduced and liquefied by the condenser.

59. A dry cleaning machine comprising, in combination; a work-treating chamber sealed from the atmosphere, and having therein a washing vat adapted to receive solvent, a perforated washing receptacle in the vat, a solvent-recovery condenser within the chamber, a duct communicating the receptacle and vat with the condenser, air-heating means, a passage communicating the condenser with the air-heating means, conduit and blower means communicating the air-heating means with the receptacle, thereby providing a circulation of air thru the receptacle and condenser, to recover the solvent from the work in the receptacle, a tank within the chamber to receive the solvent from the vat and from the solvent-recovery condenser and temporarily store it, a pipe line from the tank to the condenser to the solvent to the latter, a solvent-clarifying means for cleaning the solvent before returning it to the vat; and an interventing connection placing the tank in breathing relation with the sealed chamber, whereby the solvent will flow freely to and from the tank and vat and whereby the sealed chamber has a storing capacity to retain the solvent vapor until all thereof is reduced and liquefied by the condenser.

60. A dry cleaning machine comprising, in combination, a work-treating chamber wholly sealed from the atmosphere, and the machine being constructed and arranged to clean the work without deodorizing it; a perforated receptacle operated mounted in a vat within the chamber to tumble and whirl the work, a tank inside the sealed chamber into which the solvent drains from the vat, piping and solvent-clearing means to convey purified solvent from the tank back to the vat for reuse therein; means for circulating air through the perforated receptacle while said air is confined within the sealed chamber, air-heating means inside the chamber through which the confined air flows before it reaches the receptacle, a solvent-recovery condenser inside the chamber through which said air passes, the receptacle, a drain from the condenser to said tank; and an interventing connection from the
tank to the inside of the sealed chamber, whereby the tank and chamber are adapted to breathe back and forth in and to each other to promote vapor-pressure equalization within the machine and promote the free flow of solvent therein, and the air-circulating means being adapted to an extended operation for propelling the confined air through the receptacle until the condenser has so fully recovered the solvent that the confined air becomes purified and defumes the work without taking fresh air into the sealed chamber.

ERNEST DAVIS.