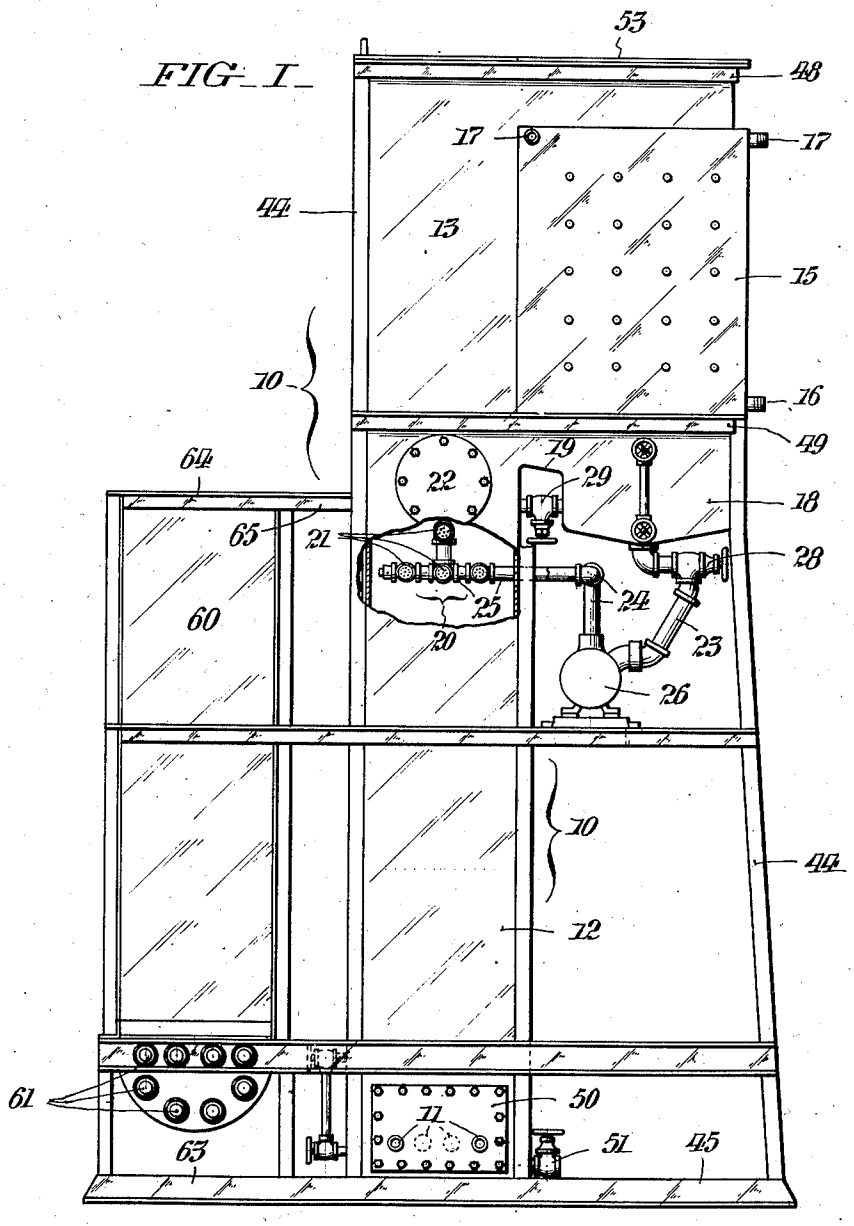
May 10, 1938. C. F. DINLEY 2,116,862

APPARATUS FOR TREATMENT WITH SOLVENTS

Filed Nov. 28, 1934 3 Sheets-Sheet 1

FIG. I



WITNESSES:
Hubert Fuchs
William Bell, Jr.

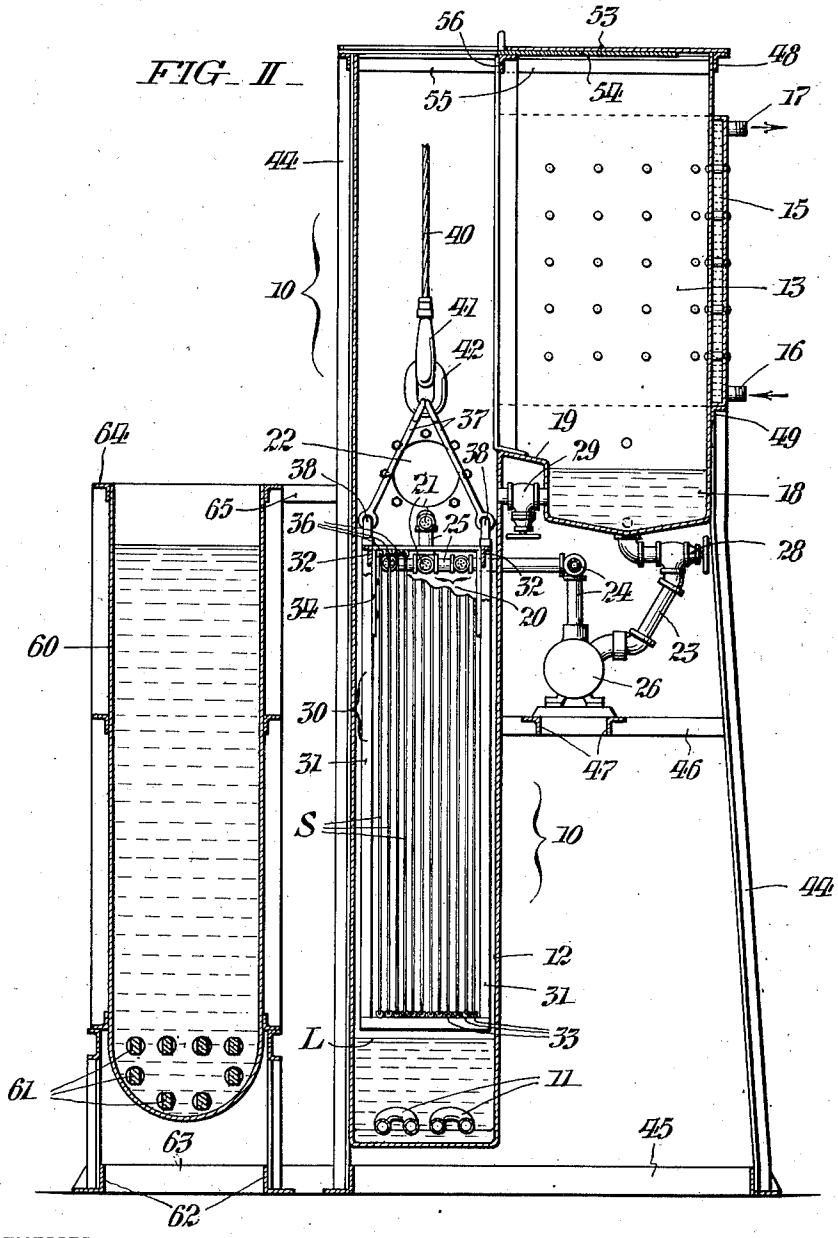
INVENTOR:
Clarence F. Dinley,
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May 10, 1938. C. F. DINLEY 2,116,862

APPARATUS FOR TREATMENT WITH SOLVENTS

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FIG. II.



WITNESSES:
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May 10, 1938. C. F. DINLEY 2,116,862

APPARATUS FOR TREATMENT WITH SOLVENTS

Filed Nov. 28, 1934 3 Sheets-Sheet 3

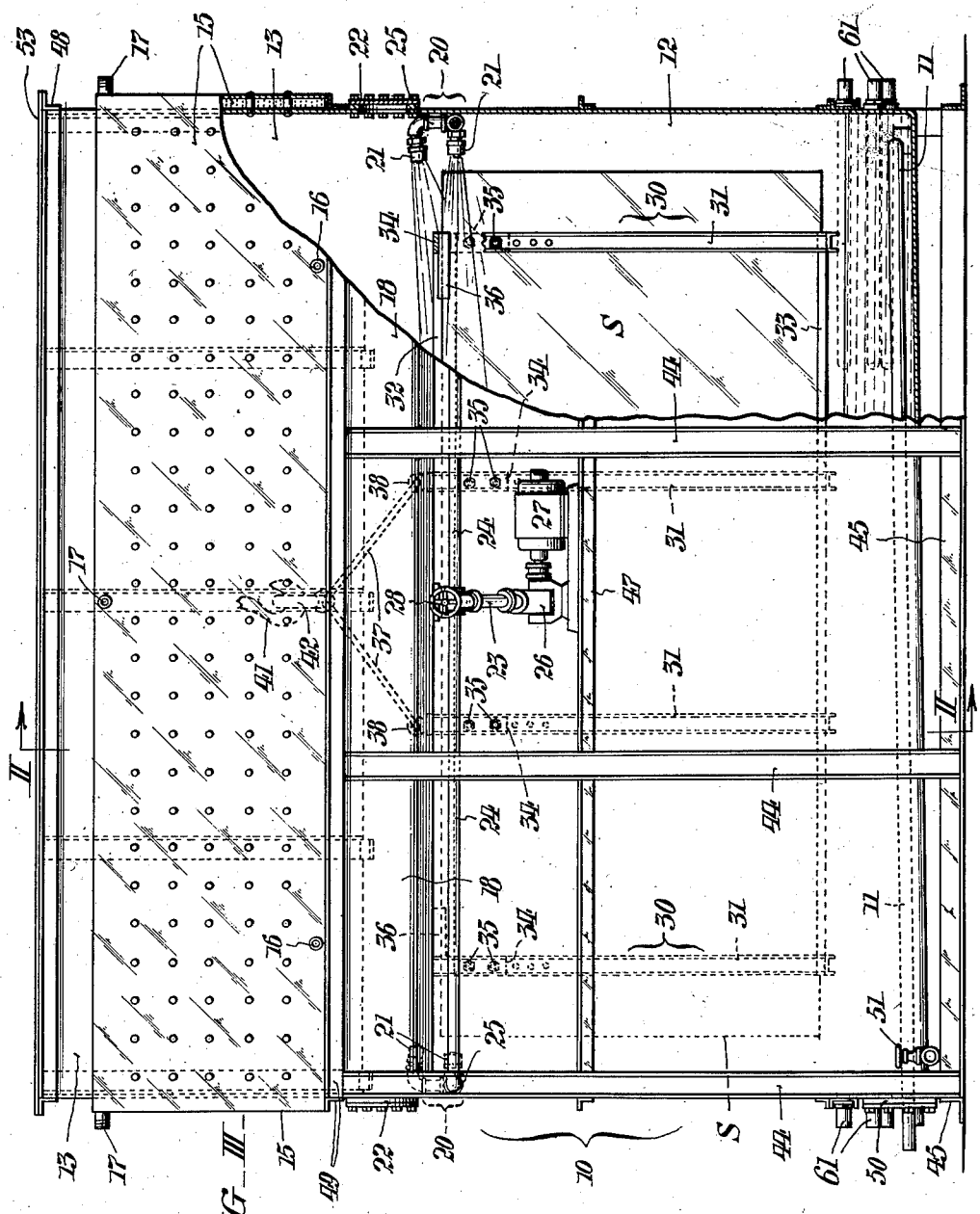


FIG. 3

WITNESSES:
Hubert Fuchs
William Bell, Jr.

INVENTOR:
Clarence F. Dinley,
BY Fraley & Paul
ATTORNEYS.

Patented May 10, 1938

2,116,862

UNITED STATES PATENT OFFICE

2,116,862

APPARATUS FOR TREATMENT WITH SOLVENTS

Clarence F. Dinley, Detroit, Mich., assignor, by mesne assignments, to Solvent Machine Company, trustee, Detroit, Mich., a corporation of Michigan

Application November 28, 1934, Serial No. 755,246

4 Claims. (Cl. 87—6)

My invention relates to treatment with solvents for such purposes as cleaning and degreasing, and to the use of volatile solvents. It is especially adaptable and useful for cleaning metal sheets, plates, or other flat articles or work. For example, plates that have been worked or operated on with the aid of lubricant may advantageously be cleaned according to my invention, either for shipment or preparatory to electroplating, enamelling, painting, or other finishing operations. Various solvents whose vapors are heavier than air may be used, such as benzine, benzol, and chlorinated solvents like carbon tetrachloride, trichloromethane, tetrachloromethane, dichlorethane, tetrachlorethane, trichlorethylene, and tetrachlorethylene, whose vapors are uninflammable. The work may be treated with the liquid solvent or with the solvent vapor, or both; and in many cases, treatment with hot or even boiling liquid solvent is desirable. In suitable forms of embodiment, such as hereinafter described, my invention affords a compact and efficient machine, wherein large quantities of work can be rapidly, thoroughly, and economically cleaned, with small labor costs and little loss of solvent. Various other features and advantages of the invention will appear from the description hereinafter of a species thereof, and from the drawings.

In the drawings, Fig. I is an end elevation of one preferred form of apparatus suitable for the purposes of my invention.

Fig. II shows the apparatus in cross-section as indicated by the line and arrows II—II in Fig. III.

Fig. III is a side view of the apparatus from the right of Fig. I, with certain portions broken away and in vertical longitudinal section.

The apparatus shown in Figs. I, II, and III comprises a sheet metal treating vessel or enclosure 10 that contains the solvent, whether used as liquid or as vapor, and is closed to exclude air and retain any solvent vapor that may be present,—purposely or incidentally,—but is preferably open upward, at the top, for the introduction and removal of work. In general, work is treated with liquid or vaporous solvent (or both) in the lower part of the vessel 10, while its upper portion serves mainly to prevent or minimize loss of solvent vapor from the vessel, especially in drying the work after treatment with the solvent. For when the solvent employed is highly volatile light gasoline or benzine; or when the work is immersed in the solvent while itself still hot or warm; or when the solvent is used hot or even boiled during use; or when the solvent is purposely used in the vapor state; or when the work is allowed to drain or dry in the upper portion of the vessel after treatment with the solvent;—in all such cases, solvent vapor will be present, and will tend to accumulate to the point of overflowing over the upper edge of the vessel 10. As here shown, the vessel 10 is provided with heating means, such as steam coils 11 near the bottom of a work-treating "well" 12 in its lower portion, for heating, vaporizing, or even boiling the liquid solvent used. The escape of solvent vapor thus or otherwise present in the vessel 10 may be prevented by suitable upward extension of its walls, and by condensation of the vapor from the upper part of the vessel.

The lower portion of the vessel 10 is internally contracted to form a deep, narrow, elongated treating "well" 12 adapted to contain the sheets or plates S to be treated, above the heating coils 11. Above the treating well 12, the interior of the vessel 10 expands to a greater width and affords lateral vapor space open to the well 12 within the vessel. It is not generally necessary that such expansion be to both sides of the well 12: on the contrary, a single lateral chamber 13 will ordinarily answer the purpose. The chamber 13 affords room or space for vapor evolving and rising from the well 12 to spread out laterally and be condensed. Condensation in the upper portion of the vessel 10 may be effected by the external atmospheric cooling of the walls, if they are of sufficient height; though generally it is preferable to supplement or (largely) replace atmospheric cooling with more effective cooling means, so that the vessel 10 need not be so deep as mere atmospheric cooling would require. The particular type and arrangement of cooling means—whether internal or external, and whether on one side, two or more sides, or all around the vessel 10—is broadly immaterial, except that the greater the extent of the cooling means perimetrically of the vessel, the less its extent vertically need be to give adequate exposed cooling area. The solvent vapor, being heavier than air, will always flow by gravity toward the region or area where it is most rapidly cooled and condensed,—just as if there were an actual outlet for the vapor at such region. As here shown, the upper vessel walls are (externally) water jacketed at 15, preferably around three sides of the chamber 13, from a little above the top of the well 12 almost to the top of the vessel 10. The jacket 15 has inlets 16, 16 for water (or other cooling medium) at its lower edge on the

right-hand side of the chamber 13, and has water outlets 17, 17, 17 at its upper edge, at the middle of the right-hand side and at its upper corners on the ends of chamber 13. Thus a cool condensing zone or region is maintained in the chamber 13, which draws the vapor rising from the well 12 aside into the chamber.

The pure liquid solvent condensed in the chamber 13 by the cooling jacket 15 falls or runs down the chamber walls, and is collected and used to treat the work S in well 12. As one means of collecting this condensate, the chamber 13 may be provided with a sump, well, or reservoir 19 at its bottom, here shown as separated from the upper part of the well 12 by a dam 19 consisting of a partition-like upward fold of the sheet metal forming the wall of the vessel 10. As shown, the top of dam 19 slopes rather gently upward away from reservoir 18 toward the crest of the dam, to facilitate overflow of drops of water floating at the surface of the solvent in reservoir 18. Such water-drops float partly submerged in the solvent in reservoir 18,—something like icebergs,—and the comparatively gentle slope of the top of the dam 19 allows solvent at any time overflowing the latter to roll these water-drops up the slope and over the crest. The atmospheric exposure of the solvent in the open vessel 10 naturally results in the presence of some water in the solvent in wells 12 and 18.

As here shown, provision is made for spraying the work S in the well 12 with liquid solvent, preferably in streams or sprays directed lengthwise of the well, or parallel with the surfaces of the plates. More even distribution of the sprayed liquid may be assured by directing the sprays on the work S from both ends of the vessel 10 and well 12. For this purpose, spray devices 20, 20 may be mounted on the end walls about at the top of the well 12,—with sufficient space between them, however, to leave the top of the vessel 10 open for the introduction and removal of sheets S substantially unimpeded. Each of the spray devices 20 comprises a sufficient number of spray nozzles 21 (four being here shown) arranged to distribute the spray fairly uniformly amongst a batch of upright sheets slightly spaced apart, and thus wash their sides thoroughly. As here shown, there are openings with removable covers 22 in the end walls of the vessel 10, affording more convenient access to the nozzles 21 for the purpose of aiming them and adjusting them to give the exact throw, spread, and fineness of spray desired. For supplying purified solvent to the spray devices 20, 20, there are pipe connections 23, 24, 24 from the well or reservoir 18 to the nozzles 21. A (rotary) pump 26, which may be driven by an (electric) motor 27, is preferably interposed between pipes 23 and 24. A valve 28 is shown interposed in the pipe 23 leading from well 18 to the suction of pump 26, to prevent undesired leakage or pumping away of solvent from the well 18. A valved connection 29 is shown from the well 18 through the dam 19 into the well 12, as a means for keeping down the solvent level in well 18 if desired.

Work may be introduced into vessel 10 and well 12, and withdrawn, by any suitable means, here shown as including a rack 30 for holding a multiplicity of plates or sheets upright and slightly spaced apart. This rack 30 is shown as including a rectangular framework including U-frames 31 of channel section interconnected at their upper ends by longitudinal angle bars 32, and at their lower ends by grooved channel-like members 33 welded to the upper sides of the bottom cross-bars of the U's. The top of each U-frame 31 is closed by an (inverted) U-yoke 34 whose side arms fit inside the yoke arms and are secured to them by bolts 35. The cross bars of the two outside yokes 34 carry short (inverted) grooved channel-like members 36 welded to the lower sides of these cross bars. The upper and lower edges of the plates or sheets S are engaged and held in the grooves of the members 33 and 36,—the plates S being inserted and removed from either end of the rack 30. The rack 30 may be supported by bails 37, 37 connected to eyes 38 attached to the upper ends of two intermediate U-frames 31, 31. The rack may be raised and lowered by a cable 40 with a hook 41 for engaging a link 42 interconnecting the bails 37, 37, by means of overhead crane, derrick, tackle, or any other convenient means.

As shown; the walls of the vessel 10 are braced by an enclosing framework comprising uprights 44 which are attached to the sides of the vessel, and also form supporting legs for it. The lower ends of the legs 44 are attached to a base frame 45 of angle section. The pump 26 and the motor 27 are mounted on an intermediate horizontal frame composed of cross angles 46 and longitudinal angles 47. The upper edge of the vessel 10 has an external rim of angles 48, and the water-jacket 15 rests on horizontal angles 49 that extend all the way around one side and the ends of the vessel, and brace its walls. The heating coils 11 are shown mounted on a side plate 50 which is removably secured over an opening in the end wall of the vessel 10, so that the coils can be taken out by simply detaching this plate 50. As shown in Figs. II and III, the bottom of the well 12 slopes downward to one end, where a valved drainage outlet 51 is provided.

Preferably the vapor and condensing chamber 13 may normally be covered over with a cover 53, shown as a plate secured to the rim 48 at its ends and at its right-hand side: this narrows the top opening of the vessel 10 to an aperture directly over the well 12 (and of substantially corresponding width) permitting easy introduction and withdrawal of work S. Means of closure for this top opening over the well 12 may preferably be provided, such as a cover plate 54 having its ends supported by internal angles 55 across the ends of the vessel 10, so that it is adapted to slide under the cover 53 when not in use, as shown in Fig. II. There is a longitudinal angle 56 under the cover plate 54, with its ends suitably secured to the ends of the vessel 10: this angle 56 serves to support the cover 54 and prevent it from sagging, especially when closed. The cover 54 may be normally left open as in Fig. II when the apparatus is in use to clean work, but may be temporarily closed at other times to minimize loss of solvent vapor from the vessel 10.

In Figs. I and II, a narrow, deep, open-top sheet metal tank 60 is shown close alongside the vessel 10; it may contain hot oil for annealing zinc, brass, copper, or other metal sheets after rolling. This tank 60 has electrical heating units 61 in its lower portion at each end, to heat the oil to the necessary temperature,—some 600° F. for annealing zinc, for example. The general construction and mounting of tank 60 resembles that of vessel 10. Its base frame 62 is shown as including or attached to lateral extensions 63 of the end angles of the base frame 45 of tank 10; and the end angles of its top angle-rim 64 have

lateral extensions 65 which are welded to the adjacent carrier uprights 44 of vessel 10.

One mode of use and operation of the apparatus shown in Figs. I–III is as follows:

The well 12 is filled with trichlorethylene or other volatile solvent about to the level L shown in Fig. II, or somewhat higher, and sheets or other work S are placed in the well above the liquid solvent. The solvent is continually heated and boiled by steam supplied to the heating coils 11, and its vapor continually rises amongst and through the sheets S, and spreads out into the chamber 13. Cooling water being all the while circulated through the jacket 15, the solvent vapor is continually condensed in the chamber 13, thus continually supplying the sump or reservoir 18 with purified liquid solvent. The valve 29 may be either open or closed at this time, but preferably open. As soon as this continual supply of solvent to sump 18 is established, the pump 26 is started into operation to supply the liquid solvent under pressure to the nozzles 21 and spray the sheets S therewith, thus washing off all oil and grease from the sides of the sheets. When the spray has sufficiently washed off the sheets S, the pump 26 is stopped; but the boiling of the solvent in the bottom of well 12 is continued until the sheets S warm up to the temperature of the hot solvent vapor in the well,—when steam may if desired be temporarily shut off from coils 11. Thereupon the hot sheets S are slowly lifted out of the vessel 10, the solvent draining and drying off from them as they rise through the upper part of the vessel above well 12, so that they come out clean and dry, and loss of solvent is substantially avoided. The apparatus is now ready for another batch of sheets.

When the solvent in the well 12 becomes so contaminated with grease and dirt that cleaning is necessary, the valves at 28 and 29 are closed, the cover 53 is preferably closed, and steam is supplied to the coils 11 and cooling water to the jacket 15 until all (or approximately all) the solvent is distilled over into the well or reservoir 18. The residue of dirt, grease, and solvent (if any) in the bottom of well 12 is drawn off at 51, and the well cleaned out. The heating coils 11 may even be removed by taking off the plate 50 on which they are mounted, to facilitate thorough cleaning of the coils and of the bottom of the well 12. After the cleaning has been completed and the coils 11, etc., replaced, the valves 28 and 29 may be opened,—thus draining most of the purified solvent back into well 12. Thereupon the apparatus is ready for operation as before.

Having thus described my invention, I claim:

1. Apparatus of the character described, for treating work with volatile solvent whose vapor is heavier than air, comprising in combination an air-excluding treating vessel open at the top for the introduction and removal of work, but internally narrowed, substantially below the top, so that its narrow lower portion forms a vaporizing and treating well for receiving the work to be treated and for containing a body of liquid solvent in its bottom, while its wider upper portion affords a chamber above and to the side of the well and laterally open thereto, said chamber being provided with a solvent reservoir at its bottom; cooling means for maintaining in said chamber a cool condensing zone for drawing the vapor rising from said well aside into the chamber and there condensing it, thus supplying said reservoir with the pure condensate; and nozzle means at a wall of said well for receiving condensate from said reservoir and spraying the work in the well therewith.

2. Apparatus of the character described, for treating work with volatile solvent whose vapor is heavier than air, comprising in combination an air-excluding treating vessel open at the top for the introduction and removal of work, but internally narrowed, substantially below the top, so that its narrow lower portion forms a vaporizing and treating well for receiving the work to be treated and for containing a body of liquid solvent in its bottom, while its wider upper portion affords a chamber above and to the side of the well and laterally open thereto, said chamber being provided with a solvent reservoir at its bottom; a cooling jacket for the chamber wall maintaining in the chamber a cool condensing zone for drawing vapor rising from said well aside into the chamber and there condensing it, thus supplying said reservoir with the pure condensate; and nozzle means at a wall of said well for receiving condensate from said reservoir and spraying the work in the well therewith.

3. Apparatus of the character described, for treating work, such as plates or sheets, with volatile solvent whose vapor is heavier than air, comprising in combination an air-excluding treating vessel open at the top for the introduction and removal of work, but internally narrowed, substantially below the top, so that its narrow lower portion forms a deep, narrow, elongated vaporizing and treating well for receiving sheets in upright position and for containing a body of liquid solvent in its bottom, while its wider upper portion affords a chamber above and to the side of the well and laterally open thereto, said chamber being provided with a solvent reservoir at its bottom; cooling means for maintaining in said chamber a cool condensing zone for drawing the vapor rising from said well aside into the chamber and there condensing it, thus supplying said reservoir with the pure condensate; and nozzle means at a wall of said well receiving condensate from said reservoir and spraying it amongst the upright sheets in streams directed substantially parallel with their surfaces.

4. Apparatus of the character described, for treating work, such as plates or sheets, with volatile solvent whose vapor is heavier than air, comprising in combination an air-excluding treating vessel open at the top for the introduction and removal of work, but internally narrowed, substantially below the top, so that its narrow lower portion forms a deep, narrow, elongated vaporizing and treating well for receiving sheets in upright position and for containing a body of liquid solvent in its bottom, while its wider upper portion affords a chamber above and to the side of the well and laterally open thereto, said chamber being provided with a solvent reservoir at its bottom; cooling means for maintaining in said chamber a cool condensing zone for drawing the vapor rising from said well aside into the chamber and there condensing it, thus supplying said reservoir with the pure condensate; nozzle means at an end of said well for spraying condensate from said reservoir lengthwise of the well on the upright sheets therein; and means for pumping the condensate from said reservoir under pressure to said nozzle means.

CLARENCE F. DINLEY.