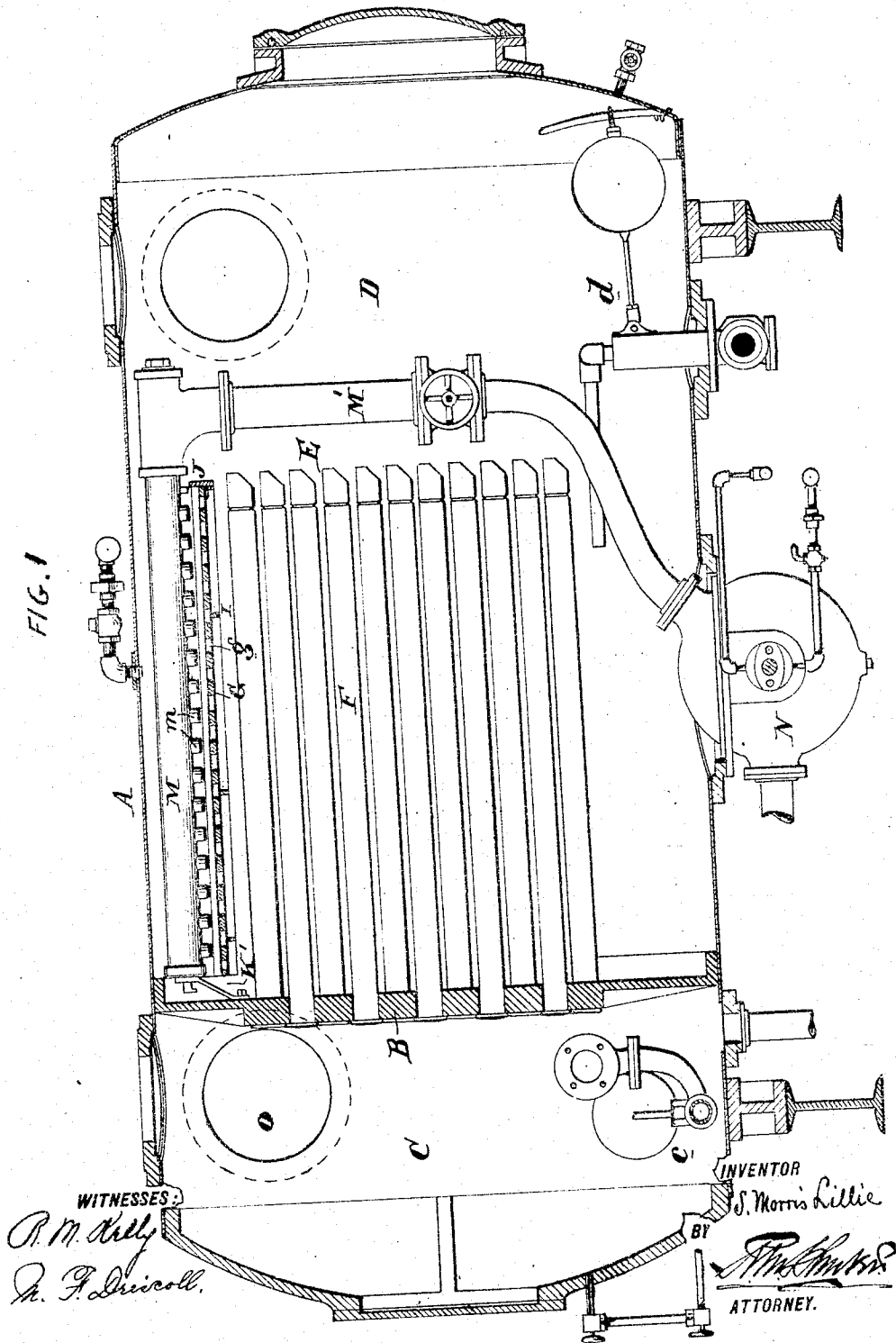


S. M. LILLIE.
EVAPORATING APPARATUS.
APPLICATION FILED JAN. 22, 1908.

Patented Nov. 2, 1909.
2 SHEETS—SHEET 1.

939,143.

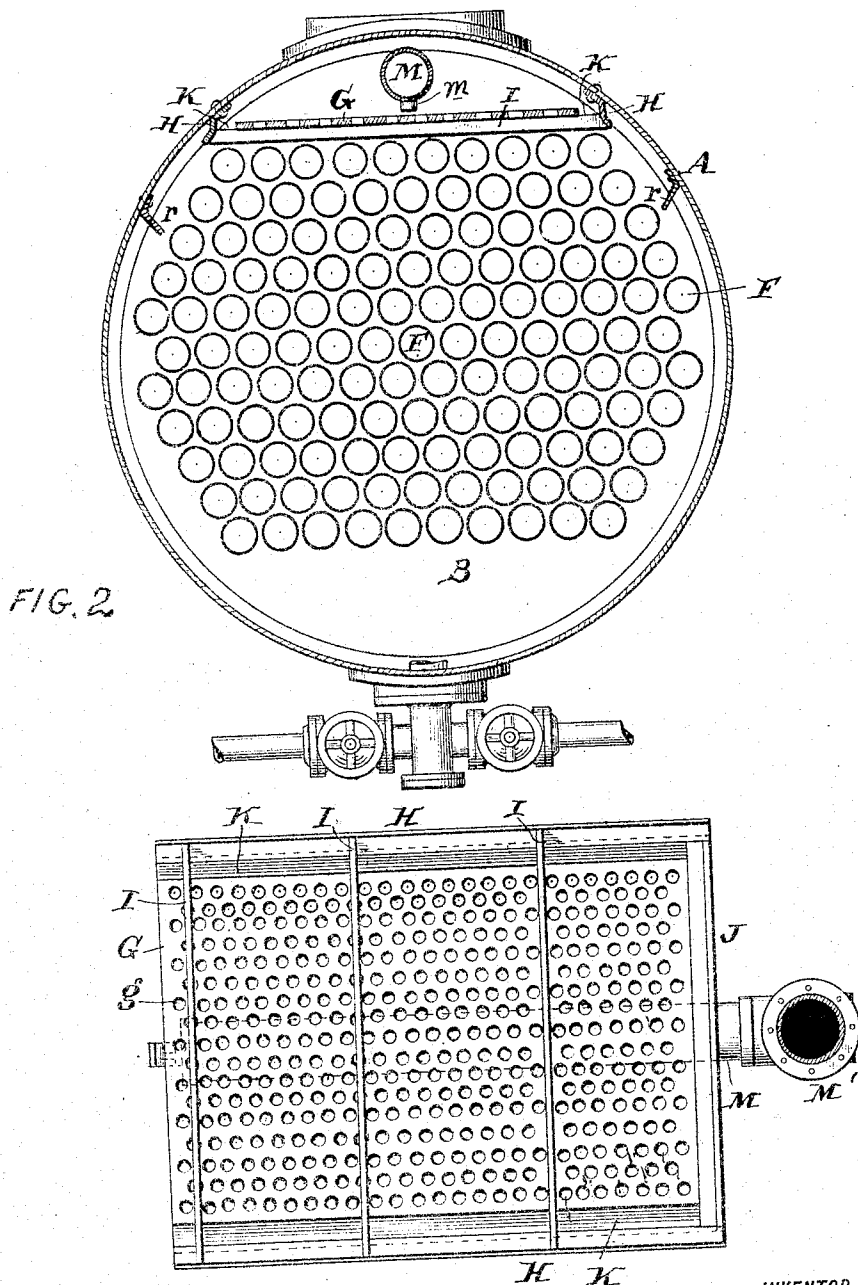
FIG. 1



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WITNESSES:
A. M. Kelly.
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FIG. 3

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UNITED STATES PATENT OFFICE.

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EVAPORATING APPARATUS.

939,143.

Specification of Letters Patent.

Patented Nov. 2, 1909.

Application filed January 22, 1908. Serial No. 412,070.

To all whom it may concern:

Be it known that I, SAMUEL MORRIS LILLIE, a citizen of the United States, residing at Philadelphia, county of Philadelphia, and State of Pennsylvania, have invented an Improvement in Evaporating Apparatus, of which the following is a specification.

My invention has reference to evaporating apparatus and consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings which form a part thereof.

More specifically, my invention relates to that form of evaporating apparatus known as the "Lillie" (and particularly employed in connection with the multiple effect apparatus) the evaporating elements of which comprise a structure in which a multiplicity of unsubmerged tubes in an evaporating chamber are maintained in a hot condition by steam or hot vapors or other heating agents on the inside, and the solution to be evaporated or concentrated is elevated and allowed to flow over the outside of the tubes.

My invention is more especially directed to the means of delivering the liquid to be evaporated upon the outside of the tubes.

The object of my invention is to provide means for distributing the liquid to be evaporated uniformly over the evaporating surfaces of the evaporator, and at the same time effect a separation from the liquid of scale or other objectionable sediment which heretofore has been troublesome in interfering with the distribution of the liquid over the evaporating surfaces, and also in fouling the latter.

My invention consists in providing an evaporator, of the general character outlined above, with a perforated distributing plate located immediately above the series of evaporating tubes and upon which the liquid to be evaporated is delivered with considerable force, preferably, from a central horizontal pipe having a series of downwardly directed nozzles, from which nozzles the liquid impinges upon the plate and spreads laterally the said plate being so formed that the scale and deleterious solid matters may escape from the lateral edges thereof under the carrying power of the sheet of liquid which moves rapidly across the plate toward and over the said lateral edges.

My invention also comprehends details of construction, which, together with the fea-

tures above specified, will be better understood by reference to the drawings, in which:

Figure 1 is a longitudinal sectional elevation through the evaporating apparatus embodying my invention; Fig. 2 is a transverse sectional elevation of same; and Fig. 3 is an inverted plan view of the perforated plate and liquid distributing pipe.

A is the body of the evaporator.

B is a vertical tube plate separating the evaporator into a steam chamber C and an evaporating chamber D.

F are a series of tubes opening through the tube plate so as to receive steam or other heating agent from the steam chamber and having their free ends E closed where they extend into the evaporating chamber. As shown in Fig. 2, these evaporating tubes F preferably fill the cylinder A transversely and are staggered in a vertical direction so that the liquid to be evaporated or concentrated will fall from tube to tube in its descent.

Arranged above the tubes is a horizontal perforated plate G, formed in sections in the case of large apparatus, which is supported upon a frame comprising sides H, cross bars I, and end frame J. The width of the perforated plate G is somewhat less than the distance between the side bars H, of its supporting frame so as to leave longitudinal passages K, K, upon each side of the plate and between it and the bars H, H for the free downward passage of liquid and scale or other impurities from off the plate. The front end of the perforated plate is substantially in line with the closed ends E of the tubes F, and the frame J at this end projects above the plate as do also the side bars (H, H) so as to prevent the liquid from flowing over the front end of the plate. The rear end of this plate, or that adjacent to the tube plate is separated therefrom to a slight extent so as to leave a passage K' to enable the liquid to flow from the perforated plate on to the surface of this heated tube plate B to keep it well deluged and take advantage of it as evaporating surface, and also to prevent material drying upon it.

The bars H are preferably somewhat Z-shaped, the upper leg being riveted to the shell A of the evaporator, the intermediate part being vertical to receive and direct the water downward, and the lower leg being flared downward to allow the liquid and

scale &c. carried by it to freely pass by its momentum toward and upon the outer tubes, *i. e.* the tubes not underneath the perforated plate. This provision for delivering the liquid upon tubes thus located in one of the valuable features of my invention, for it permits a cylindrical evaporator body to be filled with tubes clear to the walls of the shell horizontally, which has not been practicable in the Lillie evaporator as hitherto constructed. Deflecting ribs such as *r* attached to the interior surface of the cylindrical shell deliver back upon the tubes liquid which might carry to the shell and otherwise flow around its circumference without touching the tubes.

Without departing from my invention, the perforated plate may extend clear to the tube plate, and to each side of the evaporator, shell and the passages above described for permitting the flow from the plate of liquid and matters borne thereby may be replaced by apertures of large diameter or area or by slots through the plates and located at each outer edge, and at the back near the tube plate. The shape of these bars *H* may be varied.

Arranged immediately above the perforated plate *G* and centrally disposed parallel to the tubes *F* is shown a liquid supply pipe *M* having a series of nozzles *m* downwardly directed toward the upper surface of the perforated plate so that when the liquid is forced out of the nozzles it strikes the plate with considerable force and spreads laterally in opposite directions, whereby said liquid is caused to flow as a rapidly moving sheet toward the sides *H, H*. The pipe *M* is horizontal and is supported at the free end by a bracket connecting with the partition *B*. At its other end it is connected with the upright pipe *M'* extending downward through the evaporating chamber to the circulating pump *N* arranged immediately at the bottom of the evaporator cylinder *A*, this pump being of the rotary character and drawing its supply of liquid from the lower part of the evaporating chamber *D*. By means of this pump, and the several parts above specified, the liquid is circulated over the evaporating tubes. It is, of course, evident that in apparatus of this kind, the concentrated liquid may be drawn off to any extent at any time by suitable pipes and valves as well known in the art. It is also evident that so far as my invention is concerned, the liquid to the distributing pipe *M* and its nozzles may be supplied in any other suitable manner; and the particular arrangement of the evaporator as a whole may be varied, that herein illustrated and described being what is known as the "Lillie" type and is well known to those skilled in the art.

The heat is supplied by steam or hot

vapors to the chamber *C* through a suitable inlet as *O*, and the water of condensation escapes by a trap *c*. Likewise, the liquid passing into the evaporating chamber enters by a regulating valve mechanism *d* and is drawn off by a suitable pipe from the pump, but these details are unimportant to my present improvement.

The liquid is discharged with considerable force through the series of nozzles *m* practically upon the longitudinal middle line of the perforated plate *G*, it divides and moves transversely across the plate toward each side with sufficient force to carry with it pieces of scale or fibers, or other matters, which may come along in the liquid and to deliver them over the edges of the perforated plate and through the passages *K*, instead of permitting them to remain upon the plate and filling up the apertures *g* thereof. A portion of the moving layers of liquid separates itself and passes through the perforations upon the tubes below and keeps them well deluged. In this manner the perforated plate is maintained in a comparatively unclogged condition for a long period with the need of but little attention on the part of the operator, and the proper distribution of the liquor upon the evaporating tubes is maintained which is a matter of exceeding importance in an apparatus of this kind as the efficiency of the apparatus depends upon this proper distribution. A portion of the liquid delivered upon the perforated plate *G* flows off its rear end through the passage *K'* upon the vertical tube plate whereby it is utilized as an evaporating surface. The flow of the liquid down the tube plate also tends to keep it free of deposited matters. The tubes *F* are slightly inclined for the purpose of draining the water of condensation from their interiors into the steam chamber *C*.

I have shown my apparatus in the form which I have found most excellently adapted for commercial use, and while I prefer the form shown, I do not restrict myself to the minor details, as it is evident that these may be modified without departing from the spirit of the invention.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is:

1. In an evaporator, a series of evaporating tubes, combined with a horizontal perforated plate arranged above said tubes having a very large number of perforations, and a pipe extending across and above the perforated plate and having a series of openings or nozzles downwardly directed toward and close to the perforated plate whereby liquid delivered to said pipe is caused to be projected upon the plate and spread into oppositely directed thin sheets of liquid traveling over its surface away from the pipe.

2. In an evaporator, a series of evaporating tubes, combined with a horizontal perforated plate arranged above said tubes, and a pipe located practically above the middle longitudinal line of the perforated plate from one end to the other and having a series of openings or nozzles downwardly directed toward and close to the plate whereby liquid delivered to the said pipe is caused to be projected onto the plate and to spread into oppositely flowing thin sheets of liquid traveling over its surface toward its longitudinal lateral edges.

3. In an evaporator, a series of parallel evaporating tubes, combined with a horizontal perforated plate arranged above said tubes and having side passages along the edges of the plate parallel to the tubes, and a pipe supported above the perforated plate and parallel to the evaporating tubes having downwardly directed openings or nozzles opening toward and close to the plate whereby liquid is caused to be projected onto the plate and to spread into oppositely flowing thin sheets traveling over its surface toward the said side passages, a portion of the liquid passing through the perforations and the excess passing downwardly through the side passages and serving to carry away suspended matters from the plate and to wet the tubes located beyond the edges of the plate.

4. In an evaporator, the combination of a shell divided by an upright tube plate into a steam chamber and an evaporating chamber, a series of horizontal evaporating tubes extending through the upright tube plate into the evaporating chamber, a horizontal perforated plate arranged above the tubes with an unobstructed space or passages between the said upright tube plate and the adjacent edge of the perforated plate, and means for

forcing the liquid upon the perforated plate whereby it is distributed over the plate in thin sheets, a portion of the liquid passing through the perforations upon the tubes and the excess of liquid passing downward through the said space or passages onto the said upright tube plate and serving to keep it thoroughly wetted and by its flushing action to prevent deposits forming on the said plate.

5. In an evaporating apparatus a series of evaporating tubes combined with a horizontal tray consisting of a perforated floor G supported upon a frame comprising the parts H, H and J at its edges and transverse bars I beneath the same, the width of the floor being less than the distance between the said parts H, H of the frame, whereby longitudinal passages K, K are provided, combined with means for projecting upon the tray the liquid to be perforated.

6. In an evaporator, a series of evaporating tubes, combined with a horizontal perforated plate having free side edges substantially in the plane of the plate arranged above said tubes with side passages along the free edges of the plate parallel to the tubes, and means for forcing the liquid upon the perforated plate whereby it will be caused to distribute over the plate in thin sheets a portion of the liquid passing through the perforations and the excess passing downwardly through the said side passages and serving to carry suspended matters from the plate and to wet the tubes located beyond the edges of the plate.

In testimony of which invention, I have hereunto set my hand.

S. MORRIS LILLIE.

Witnesses:

R. M. HUNTER,
R. M. KELLY.