No. 789,159. PATENTED MAY 9, 1905.

S. M. LILLIE.

MULTIPLE EFFECT EVAPORATING APPARATUS.

APPLICATION FILED OCT. 10, 1904.

3 SHEETS—SHEET 1.

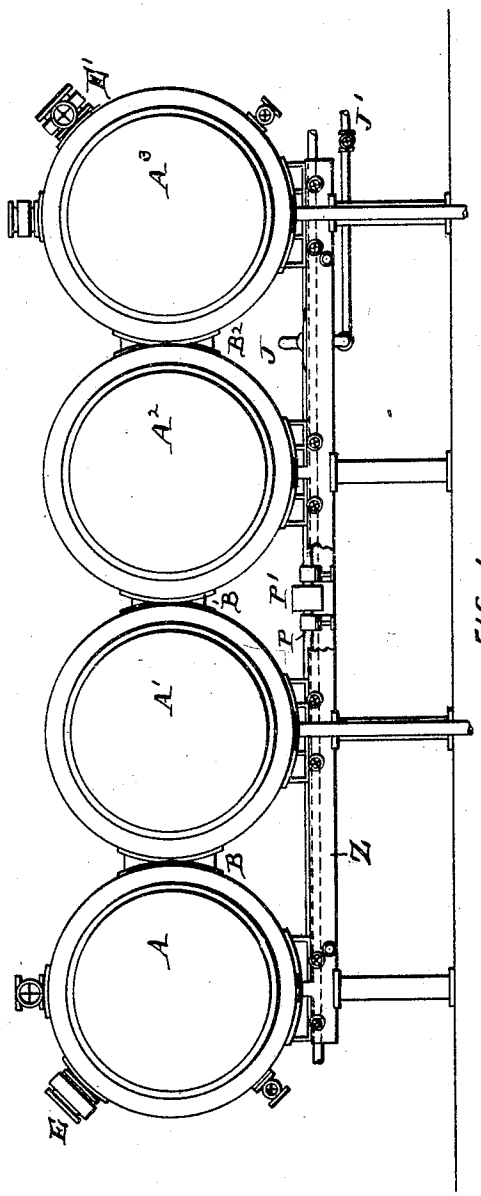


FIG. 1

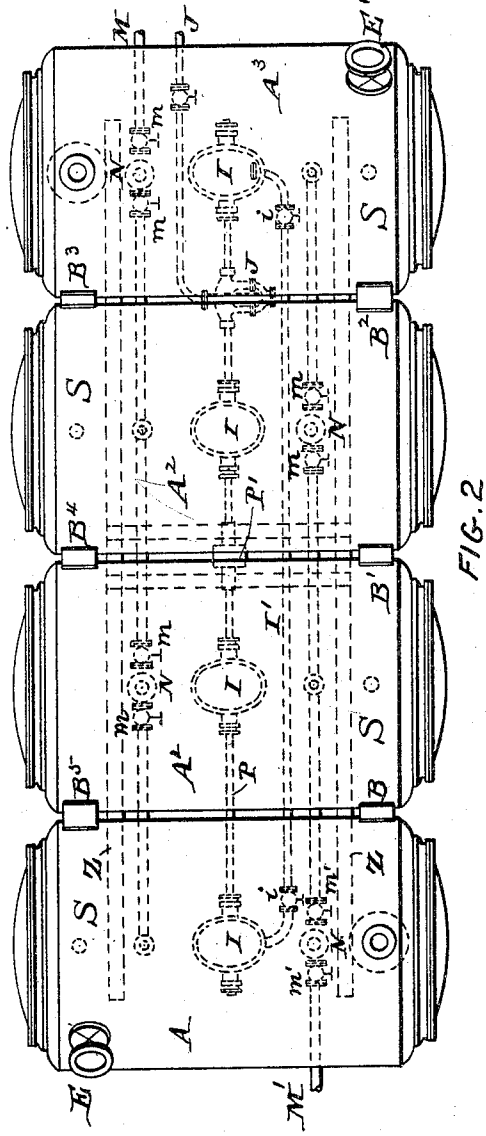


FIG. 2

Witnesses
D. Webster, Jr.
P. M. Kelly.

Inventor
S. Monds Lillie
By
Attorney.

No. 789,159. PATENTED MAY 9, 1905.

S. M. LILLIE.

MULTIPLE EFFECT EVAPORATING APPARATUS.

APPLICATION FILED OCT. 10, 1904.

3 SHEETS—SHEET 2.

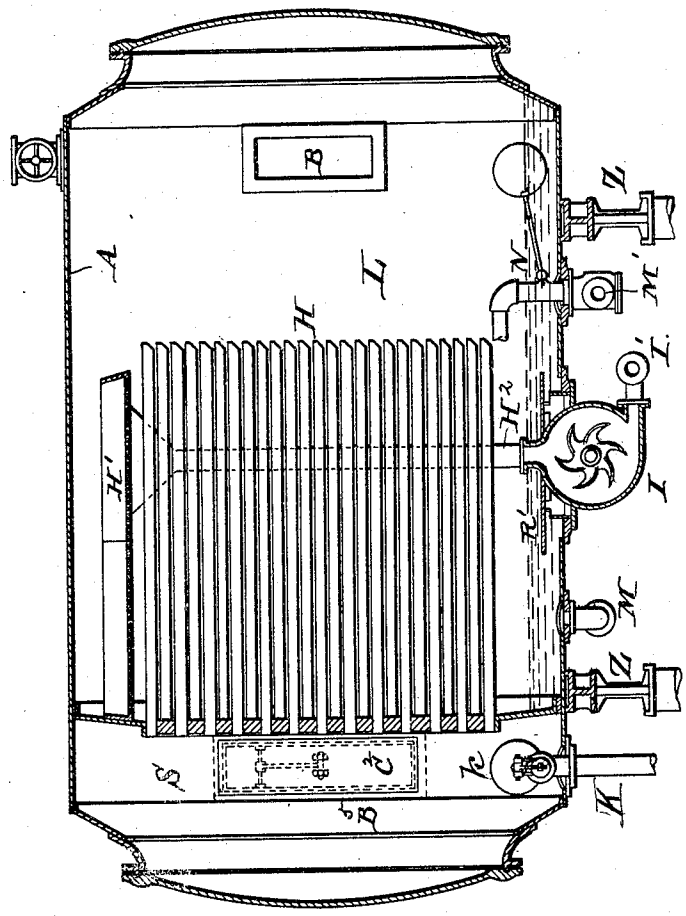


FIG. 3

Witnesses
D. Webster, Jr.
R. M. Kelly.

Inventor
S. Morris Lillie
By
Attorney

No. 789,159. PATENTED MAY 9, 1905.

S. M. LILLIE.

MULTIPLE EFFECT EVAPORATING APPARATUS.

APPLICATION FILED OCT. 10, 1904.

3 SHEETS—SHEET 3.

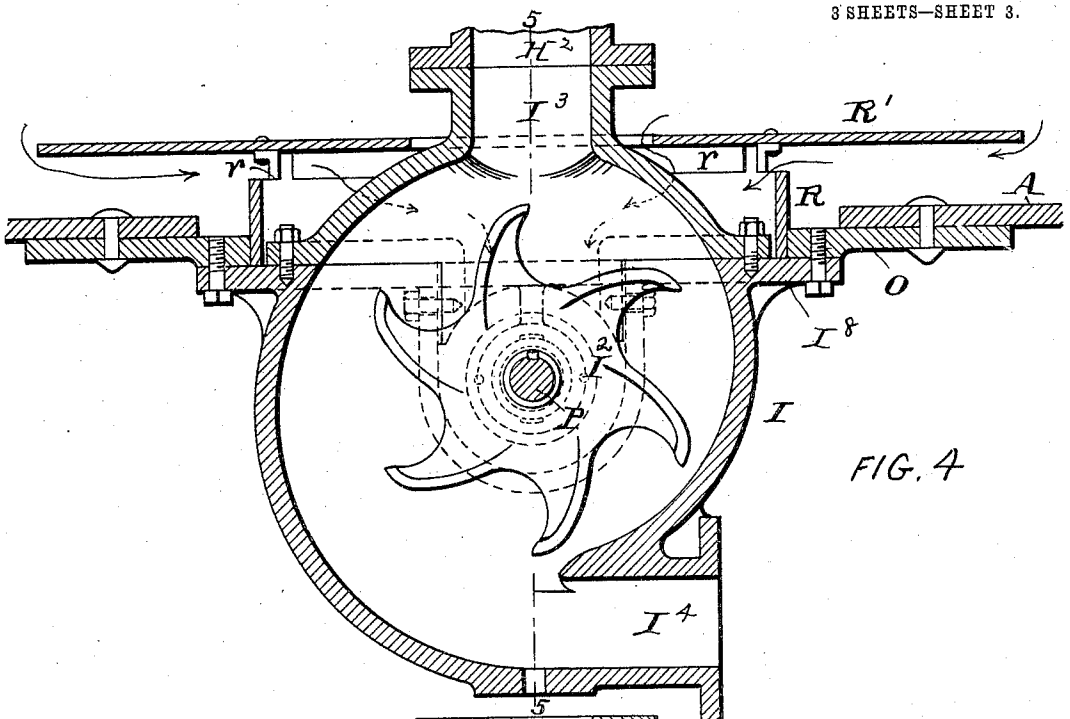


FIG. 4

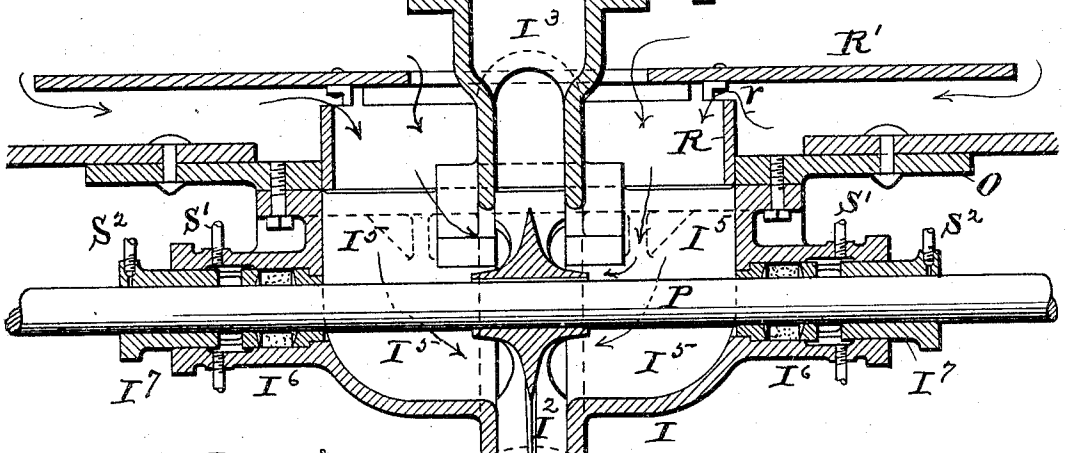


FIG. 5

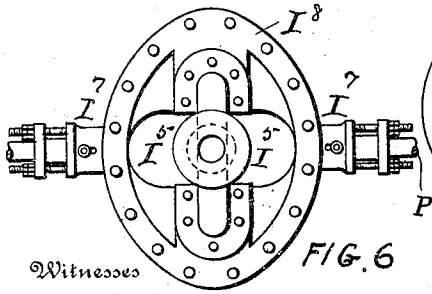


FIG. 6

Witnesses

D. Webster, Jr.

R. M. Kelly.

Inventor

S. Morris Lillie

By

Attorney

No. 789,159. Patented May 9, 1905.

UNITED STATES PATENT OFFICE.

SAMUEL MORRIS LILLIE, OF PHILADELPHIA, PENNSYLVANIA.

MULTIPLE-EFFECT EVAPORATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 789,159, dated May 9, 1905.

Application filed October 10, 1904. Serial No. 227,826.

To all whom it may concern:

Be it known that I, SAMUEL MORRIS LILLIE, of the city and county of Philadelphia and State of Pennsylvania, have invented an Improvement in Multiple-Effect Evaporating Apparatus, of which the following is a specification.

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

Heretofore it has been customary in multiple-effect evaporating apparatus of the Lillie type to locate the pumps for circulating the liquor within the effects upon foundations specially built for them and to connect them with the effects by exposed pipes through which the liquor passes. The objection to this resides in the fact that it is costly to construct, involves the danger of leaking joints because of uneven settling or excessive vibration, permits loss of heat from the liquor, and requires power to overcome the circulation in the lengthy pipes required.

The object of my invention is to overcome the objections mentioned above and at the same time improve the general design and simplify the apparatus.

In carrying my invention into practice I arrange the several effects side by side upon suitable supports or foundations and attach the several liquor-circulating pumps directly to the bottoms of their respective effects, whereby said pumps are supported, through the structure of the effects, upon their foundations. I prefer to operate said pumps by a shaft common to all of them. These pumps have their suction or intake passages opening directly into the interior of the effects and discharge upward through the chamber of the effect to the distributing device, whereby the shortest possible circuit of circulation of the liquor is obtained and chilling by circulation of outside piping is avoided.

My invention also comprehends details of construction of the pump, which, together with the features above specified, will be better understood by reference to the drawings, in which—

Figure 1 is an elevation of a multiple effect embodying my invention. Fig. 2 is a plan view of same. Fig. 3 is a sectional elevation through one of the effects and its circulating-pump. Fig. 4 is an enlarged sectional elevation of the pump shown in Fig. 3. Fig. 5 is a sectional view of the pump, taken on line 5 5 of Fig. 4; and Fig. 6 is a plan view of the pump removed.

A, A′, A^2, and A^3 are four effects of the horizontal type and supported side by side by suitable girders Z, carried upon columns or other suitable supports or foundations. This type of multiple effect is known as the "Lillie" multiple effect and is more fully described in my application, Serial No. 214,500, filed June 28, 1904. I, however, do not confine my present invention to any particular type of multiple effect. In the type of effect shown the steam or heating chambers S are arranged at opposite ends in adjacent effects. L is the liquor-evaporating chamber and contains the evaporating-tubes H. The liquor to be vaporated is pumped from the bottom of the chamber L by circulating-pump I, secured directly to the body of the effect, and forced upward through pipe H and sprayed from the perforated distributing-pan H′, which distributes it upon the evaporating-tubes. The pumps I of the effects A and A^3 are connected by a pipe I′, having valves *i i*, and this pipe between the valves is connected with the discharge-pump J, which is employed to discharge the condensed liquor by pipe J′. The liquor is supplied to the several effects in series beginning with either effect A or A^3 by pipes M′ and M, respectively. When the effect A is to receive the thin liquor, it is supplied by pipe M′, through a valve *m′* and by a regulating float-valve N, into the bottom of the evaporating-chamber L. From this effect the liquor passes by a pipe M, through a valve *m* and by a similar float-valve N, into the bottom of the effect A′. The passage of the liquor in a gradually more concentrated condition passes in a similar manner from effect A′ to effect A^2 and from it to effect A^3, whence it is discharged through the pump I, pipe I′, valve *i*, and discharge-pump J. During the time the liquor is flowing, as thus described, the steam is supplied by valved pipe E to the

steam-chamber S of effect A, and the water of condensation is conveyed away by pipe K through a steam-trap *k*. The vapors from the evaporating-chamber of effect A pass through passage B into the steam-chamber S of effect A′. The vapors from the evaporating-chamber L of this effect A′ pass by passage B^4 into the steam-chamber S of effect A^2. The vapors from effect A^2 pass by passage B^2 into the steam-chamber of effect A^3, and the vapors of the evaporating-chamber L of this last effect are condensed in any usual way. The various passages are controlled by valves, such as shown at C^2, for example, and which are open to allow the vapors to pass freely through the passages above referred to. When the system is to be reversed, the liquor is circulated in a similar manner to that described, but in the reverse direction, being fed into effect A^3 by pipe M and then passed successively through the several effects under the control of the float-valves until it is finally discharged through the discharge-pump J, which draws from the pump I of the effect A. The several valves M are adjusted to insure the proper direction of circulation of the liquor. As shown, the pipe M communicates directly with effects A and A^2 and indirectly through the float-valves N with effects A′ and A^3. The valves *m m* permit the flow of liquor from pipe M through float-valves N, but not beyond said valves. The same is true of the pipes M′ and valves *m*′. The flow of the liquor having been reversed through the several effects, the valves in the passages B to B^5 are reversed also, and then the vapors pass as follows: Steam is shut off by valve E and admitted to the steam-chamber S of effect A^3 by steam-valve E′, where it is condensed, and the water of condensation escapes by the steam-trap, as before. The vapors generated in the evaporating-chamber of this effect pass through passage B^3 into the steam-chamber of effect A^2 and are condensed. The vapors of the evaporating-chamber of effect A^2 pass by passage B′ into the steam-chamber of effect A′ and are condensed. The vapors from this effect pass by passage B^5 into the steam-chamber of effect A and are condensed, and the vapors of evaporating-chamber of effect A are condensed by a suitable condenser (not shown) in any suitable or well-known manner.

While I have described in detail my preferred and reversible type of multiple effect adapted to be used in connection with my improved pump, it will be understood that the multiple effect need not be reversible nor restricted to any type. Moreover, my improved circulating-pump is adapted for use in a single effect, if so desired, or with any tank for any other purpose.

Referring now more specifically to the construction of the circulating-pumps I, (shown in Figs. 4, 5, and 6,) they consist of the following characteristic features: The case is flattened and preferably somewhat spiral, paddle-wheel I^2, the blades of which are shaped to catch and drive the liquor. This wheel I^2 is secured to a rotating shaft P, having bearings in the glands I^7 of the stuffing-boxes I^6. The upper part I^3 of the case is detachable to enable the wheel to be inserted and also contains the discharge-outlet, to which is bolted the inside circulating-pipe H^2. The central portion of the paddle-wheel case is open on each side and communicates with the intake-passages I^5, extending laterally and upward, as shown. I^4 is a discharge at the bottom of the pump to connect with the discharge-pipe I. The pump has a flange I^8 near its upper part, which is bolted to a casting O, riveted to the bottom of the cylinder of the effect and forming an opening therein, which is closed by the pump and through which the liquor finds its way into the intake-passages I^5. To prevent vortices at the intake-passages, the opening in the casting O is surrounded with an upright wall R, surmounted with a plate R′, held a short distance above it, so as to form passages *r*, through which the liquor passes, as indicated by arrows. The flow of the liquor is also deflected by the plate R′ and in passing around its edges is caused to take a circuitous course, and consequently cannot produce vortices. The upright wall R serves as a dam to hold back from the pump particles of scale which may fall from the tubes and settle in the bottom of the effect.

The pipes S′ supply water to the stuffing-boxes I^6 to make a water seal against the inflow of air, and the pipes S^2 supply oil to the glands to lubricate the bearings therein in which the shaft P rotates.

By carefully alining the several effects it is evident that the shaft P, connecting the several pumps, will run true and may be driven by a belt-wheel P′ or in any other convenient way. It will also be seen that by keeping the discharge-pipe H^2 wholly within the effect it is made much shorter than if arranged on the outside of the apparatus, and in case of leaking joints no loss results, because the pipes are wholly within the effect.

In general appearance the apparatus is greatly improved over constructions heretofore in common use. It is simpler, cheaper, more durable, and more easily kept in repair than those types where the pumps are supported upon independent foundations.

While I prefer the construction set out as excellently adapted for the employment of my invention in practice, I do not limit myself to the details, as they 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. The combination of two or more effects, of a multiple-effect evaporating apparatus, with a circulating-pump secured directly to

and carried by each of the effects, and a shaft common to all of the pumps for operating them.

2. In an evaporating apparatus the body of the evaporator, combined with a circulating-pump wholly supported by the body and secured upon the lower and outside surface thereof so as to be detachable from the outside and having intake-passages opening directly from the interior of the body.

3. In an evaporating apparatus, the body of the evaporator, combined with a circulating-pump wholly supported by the body and removably secured upon the lower and outside surface thereof so as to be detachable from the outside and having intake-passages opening directly from the interior of the body, whereby the pump as a whole may be readily removed from the outside of the body without disturbing the interior structure.

4. In an evaporating apparatus, the body of the evaporator having an opening through its bottom, combined with a circulating-pump fitted over said opening and having a flange secured to the outside surface of the body around the opening so that the pump is directly supported by the body and detachable from the outside and in which the pump is further provided with intake-passages opening directly into the interior of the body through the said opening in its bottom.

5. In an evaporating apparatus, the body of the evaporator, combined with a circulating-pump having its weight wholly supported by the body and being removably secured directly to the body upon its outside and lower part and having intake-passages opening from the interior of the body, and means wholly within the body for causing the liquor to take a circuitous course in passing from the body to the intake-passages.

6. In an evaporating apparatus, the combination of the body of the evaporator, with a circulating-pump secured to the lower part of the body having intake-passages opening directly from the body to the pump, and means within the body for causing the liquor to take a circuitous course in passing from the body to the intake-passages consisting of a plate R′ placed above the said intake-passages.

7. In an evaporating apparatus, the combination of the body of the evaporator, with a circulating-pump secured to the lower part of the body having intake-passages opening directly from the body to the pump, means within the body for causing the liquor to take a circuitous course in passing from the body to the intake-passages consisting of a plate R′ placed above the said intake-passages, and an upright wall R surrounding the intake-passages and supporting the plate R′ with liquor-passages between them.

8. A liquor-tank, in combination with a circulating-pump mechanically connected with the outside of the bottom of the tank whereby its weight is wholly supported by the tank and it is also removable from the outside of the tank and in which the said pump is provided with intake and discharge passages opening into the tank, a rotatable paddle-wheel, a shaft for rotating the paddle-wheel journaled in the pump-casing and wholly outside of the tank, and stuffing-boxes for the shaft also arranged outside of the tank.

9. A liquor-tank, in combination with a circulating-pump mechanically connected with the outside of the bottom of the tank whereby its weight is wholly supported by the tank and it is also removable from the outside of the tank and in which the said pump is provided with intake and discharge passages opening into the tank, a rotatable paddle-wheel, a shaft for rotating the paddle-wheel journaled in the pump-casing and wholly outside of the tank, and stuffing-boxes for the shaft also arranged outside of the tank, and means located within the tank for causing the liquor to take a circuitous course in passing from the tank into the intake-passages of the pump.

10. The combination of a liquor-tank, with a pump consisting of a casing made in separable upper and lower parts the latter being secured directly to the outside of the bottom of the tank so as to have its weight wholly supported by said tank and be movable from the outside thereof, the said pump having intake-passages in the lower part of its casing and a discharge-passage into the tank from the upper portion of the said casing, a rotatable paddle-wheel within the casing, and a shaft for rotating the paddle-wheel journaled in the lower part of the casing and wholly below and outside of the tank.

11. The combination of a liquor-tank having an opening in the bottom, with a circulating-pump casing secured to the outside of the tank and covering the opening therein and having a central paddle-wheel compartment and two intake-passages respectively extending downward on each side of the paddle-wheel compartment and opening centrally therewith, the rotatable paddle-wheel, and a shaft outside of the tank to rotate it journaled in the casing.

12. In an evaporating apparatus, the combination of the body of an evaporator, with a circulating-pump mechanically attached to the outside of the lower part of the body whereby it is removable from the outside of the body and its weight is wholly carried by the body, said pump having a discharge-opening from the top directly into the interior of the body an intake-passage from the interior of the body, and a discharge-port from the pump exterior to the body for removing the liquor from the body.

13. In an evaporating apparatus, the combination of the body of an evaporator, with a circulating-pump mechanically attached to the outside of the lower part of the body whereby it is removable from the outside of the body

and its weight is wholly carried by the body, said pump having an intake-passage from the interior of the body, and a discharge-port from the pump exterior to the body for removing the liquor from the body.

14. In an evaporating apparatus, the combination of the body of an evaporator, with a circulating-pump secured to the lower part of the body having intake-passages opening directly from the body to the pump, and a wall R surrounding the intake-passages to hold back scale and matters settling on bottom of the body.

In testimony of which invention I hereunto set my hand.

SAMUEL MORRIS LILLIE.

Witnesses:
R. M. KELLY,
M. J. EYRE.