pulled to return to the rectifying column, and the operation is closed when what passes through the test glass ceases to exhibit any appreciable strength. All parts of the apparatus are now to be emptied. H is emptied by h, and the deposit removed through the plug hole k. B is emptied by b, the return pipes by o o; D is emptied by t into E, and this last by x.

When the distillation is stopped for four or five days only, the simpler plan will be to leave the apparatus charged, and extinguish the fire when the wine ceases to flow from A.

To Cleanse the Apparatus.—The cleansing of the different parts of the apparatus is very important.

The distilling column is cleansed, when the plates are of wire gauze, by removing one after the other the plates which are within, and are attached to brass rods running from top to bottom. These plates are removed, washed, and scraped very easily. When the plates are of sheet metal they are movable or fixed; when movable they may be removed and cleaned one by one as for the plates of wire cloth; when fixed they are cleaned by passing steam through the column. The steam is produced by heating water in the stills D and E. The piece G, in which the rectifying plates are always fixed, is to be cleansed by steam as above. This cleansing of the plates in G is both useful and necessary, because towards the end of the operation there accumulates in them a considerable quantity of essential oils, resulting from the substances which have been distilled. These essential oils have a very offensive taste, and a very small quantity will suffice to spoil a large quantity of spirits. It is well then when the operation is closed to pass through the whole apparatus a quantity of the steam of water to remove these essential oils as much as possible.

The cleaning of the outside of the coil in B is quite easy; by removing the cover m m, this coil may be reached by a broom or brush. The washings are drawn off by removing the plate which supports the cock b.

The piece $H$ is cleaned by taking off the movable cover of the cylinder, when the coil will be exposed to view, and may be reached by a swab or brush.

It is best to keep these coils $B$ and $H$ as clean as possible, because when these surfaces are covered with a deposit the transmission of heat is interfered with, and the apparatus works irregularly.

To prevent deposits from collecting at the bottom of $H$, and at length closing the mouth of the tube a a, there is placed in the midst of $H$ a long brass rod called an agitator, the upper end of which is bent into a handle, and which has attached at the lower extremity a small disk of leather with which the liquid at the bottom of $H$ is stirred from time to time, so as to distribute the deposit through the mass to be carried forward by the current.

Safeguard.—When called on to distil wines that are very rich in alcohol, as in the South of France and other warm countries, it is proper to add to the apparatus of Derosne a supplemented piece called an evaporator or safeguard (Fig. 3, Pl. II.).

This piece is placed between $B$ and $H$; it consists of two concentric cylinders placed vertically, leaving an annular space between them. Along and over the surfaces of these cylinders which are exposed to the air a small quantity of water is caused to trickle, which by its evaporation will remove a large portion of heat from the alcoholic products as it passes from $B$, and before it reaches $H$. Without this arrangement the alcoholic product would be too abundant in such rich wines to be condensed by the liquid itself.

The following is a description of the different parts of the apparatus:

- $b$ $b$. Inner cylinder of copper.
- $c$ $c$. Outer cylinder of copper.
- $d$. Annular space which receives the products from B. This space is divided by sundry partitions which cause the liquid to come in contact with every part of the surface $b$ $b$ and $c$ $c$.
- $f$ $f$. Little gutter around the bottom of the safeguard.
to collect the water which has passed over the surfaces of the cylinder. 

-_a'_ a'. Extension pipe placed in the axis of the cylinder in order to elongate a a' of Fig. 1, to make room for the attachment of this piece.

e. Tube by which the alcoholic liquid is conducted from the coil B into the annular space d d.

c. Tube by which the liquid reaches the coil H.

x x. Circular gutter at the upper part of the safeguard from which water is caused to trickle over the surface.

It is well to cover the surface e e and b b with cotton cloths which should dip into the gutter x x, and which by their capillary attraction will convey to these surfaces a sufficient quantity of water for the proper working of the apparatus.

By the assistance of the supplemental apparatus the richest wines are perfectly exhausted of the alcohol they may contain.

Observations.—After this rapid survey of the general course of the distillation, in order to give a general idea of it, we now propose to go more into details on certain points which are important to the proper handling of the apparatus.

All the success of continuous distillation by means of this apparatus depends in principle upon the desired quantity of vapor which is produced in the stills D and E, being in proportion to the stream of wine that flows from A'.

When this proportion is not as it should be, certain accidents occur during the course of the work which it is our duty to make known.

As we have said above, when the stream of wine which flows from A' is once fixed according to the quantity which it is desired to distil in an hour, it should not be touched any more, but the whole operation should be regulated by the fire.

The indicators f and f', applied one to the column G and the other to the column C, indicate with sufficient accuracy what is going on within the apparatus.

When the distillation is very abundant, when the degree of spirituousity diminishes very rapidly, and the liquid is seen to rise in the indicator f' beyond its middle point, we may conclude that there is too much watery vapor produced by E, and the fire must be checked by closing the register of the furnace.

If the liquid in the indicator f becomes discolored it is necessary to reduce the fire at once, unless we would see the liquid to be distilled pass into B, and come over through j, mixed with the product of distillation. These effects are easy to be understood; the steam which is generated in D and E, being too abundant and having too much tension, interferes with the descent of the wine by the column C; the wine accumulates in the plates of this column, and rises successively into those of the rectifier G, mixes with the low wines, colors them, and risks passing into the condensing coil of the wine-heater B, and thence into the coil of the cooler H. This is what is announced by the indicator f and f'.

If it happens, in consequence of insufficient attention, that there should be too great a disturbance in this way in the working of the apparatus, we may, in order to establish the equilibrium more promptly, increase the stream of wine from A', at the same time that the fire is reduced; this will cause a more prompt condensation of the vapors, but this expedient should be resorted to only in case of a serious accident.

The distillate should always reach the test jar j cold; if it comes over warm, it shows that the fire is too active.

It is on the operation of the return cocks n n' n'' that is based the whole system of rectification by this apparatus, which enables us to procure even from the poorest materials spirits of the highest proof.

For a proper comprehension of the effect of these return cocks, it is necessary to conceive that the products are richer in spirit as the part of the coil in which the condensation takes place is remote from d.

In fact, the vapor which passes into the coil by d is a mixture of the vapors of water and alcohol in certain proportions; the vapor of water is more easily condensed
than the vapor of alcohol; since, in order that the former may be reduced to the form of water, it is sufficient to have the cooling liquid a little below 100° C., while the alcohol continues in a state of vapor until the temperature of the surrounding liquid is reduced to 40° C.

It is understood, then, that when the vapor, a mixture of alcohol and water, passes into the condensing coil \( B \), a portion of the watery vapor is condensed, and that which passes further on is more highly charged with alcohol. In the next turn of the coil another portion of vapor of water is condensed, thus rendering the aëri-form product still more alcoholic, and so on until by advancing towards \( e \) the vapor is so far cooled down that the vapor of alcohol is itself condensed.

We observe by this that the further it advances in the condensing coil, from \( d \) towards \( e \), the stronger will be the alcoholic product which condenses therein. This being taken for granted, since all the product that condenses in the different turns of coil \( B \) pass into the horizontal return pipe \( xx \), by means of the small vertical tubes which correspond to them, we see that, if by opening the return cock \( a \) we cause to return into the rectifier \( G \) all that has been condensed in the first part of the coil from \( d \) to \( n \), we shall receive in the proof-bottle \( j \) a stronger product than we should have obtained if the three cocks had been closed, and the whole of the product had passed through the cooler \( H \). If we open \( n' \) we shall have a still stronger product, and by opening \( n'' \) we shall only have what is condensed in the last turn of the coil of \( B \), and consequently this will be the strongest spirit that can be produced by the apparatus.

The office of the rectifier \( G \) is also easy of comprehension. This rectifier is divided internally by plates superposed one above the other, which each retain a portion of the low wines which pass through the return pipe from the coil of \( B \). The alcoholic vapor which rises from \( C \) plunges successively into each of these plates, commencing at the lower and passing on to the upper one. This vapor is enriched by plunging into the already strongly alcoholized liquid returned from the coil, and is enriched more and more, because the more spirituous product is returned to the upper plates; for it may be seen that the product from the cocks \( n' \) \( n'' \) are emptied into a part of the rectifier above that from the cock \( n \).

The proof bottle \( j \) is an instrument through which the distillate passes previous to being received in vessels destined to hold it. Into this proof bottle is plunged an alcoholmetre, which indicates at each moment of the operation, the alcoholic strength (or degree) of the liquid which flows from the coil \( H \). By inspecting this instrument, the workman is guided in his labor according to the degree of strength required.

Closing Remarks in regard to the Apparatus of Derosne.—To prevent all leakage, the joints of this apparatus are made by interposing between the two surfaces, a circular washer of cardboard smeared with some greasy substance or a mixture of red and whitelead ground in oil, and brought together with clasps or bolts.

The various joints which are not made as above, but by fitting into a socket such as the fittings of the glass indicators, &c., should be luted very carefully. This lute is prepared by mixing red lead with the ordinary white paint, which is whitelead well ground in a dryoing oil, so as to form a paste having the consistency of glazier's putty. Bands or strips of cloth greased with this paste are used to cover the joints.

A good lute is made by mixing equal parts of wheat flour and Spanish whiting in fine powder with the white of egg. Strips of cloth dipped in this mixture are to be applied to the joints as above.

In setting the glass indicators, care must be taken not to close the orifices of the pipes, which connect them with the interior of the apparatus, which will happen if the tubes are too long, for then the liquid cannot have access to the tubes, and the indicator will be useless.

The first product which flows from a new apparatus has a taste of copper and resin; this soon ceases. If this is not thrown away, it should be put aside to be mixed with the wine or for rectification.
It is always important to commence, as was indicated when describing the process for starting the operation, by filling the wine-heater and cooler with the liquid to be distilled, before raising the fire under the stills, and sending steam through the different parts of the apparatus, for if we commence by raising the steam and turn on cold water, there is risk of crushing the apparatus under the weight of the atmospheric pressure in consequence of the formation of a vacuum.

When the operation is started, care must be taken not to allow cold liquid to flow into the stills when the ebullition has commenced, for fear of a similar accident. Care must be taken during the first heating to arrest the flow of wine into the stills, by closing the cock of the regulating tub, until the wine-heater is too hot for the hand. When the liquid is heated to this point, we may without hesitation allow it to flow into the distilling column; there is no longer any risk from the condensation of the steam, and the operation may go on continuously.

In starting the operation when the steam begins to pass from the first still into the second, by means of the goose-neck, a loud noise is produced, sounding like the blow of a hammer in the second still. The noise is occasioned by the instantaneous condensation of the steam as it passes from the first still into the cold or only tepid liquid in the second, thus forming a kind of vacuum. This noise will continue until the liquid in the second still has acquired a sufficiently high temperature. The steam produces a similar noise, only much feebleer, as it passes over each division of the distilling column.

Egrot's New Apparatus for Continuous Distillation.

The difficulties to be avoided and the care to be observed, in order to obtain good results by means of the distilling apparatus used at the present time, have induced M. Egrot to seek to improve this state of things. After many efforts crowned with success, this skilful artificer has succeeded in constructing a new apparatus which fulfills all the required conditions. Simplicity of use and management, richness in degree, facility of setting up and cleaning, economy of fuel, space, and transportation, and of moderate price.

The theory of this new apparatus is based on one of the most simple principles, that of the direct or multiplied contact of vapor, under a feeble pressure, with the wine to be distilled. By this means, acting on a small quantity of wine, we obtain a rapid ebullition; and the separation of the alcohol is very promptly effected. Producing its effects in a small space, and over a great extent of surface, the apparatus exhibits the best conditions for economizing fuel; on the other hand, the feeble pressure existing in the column by reason of the small number of plates of which it is composed affords but little resistance to the passage of the alcoholic vapors, and the distillation is effected in a most simple and easy manner.

The apparatus is not liable to the accidents which so frequently occur in those with a high column. The distiller charged with its management need not fear irregularities in the distillation in spite of too active a heat when using the open fire, or from too great a flow of steam when this agent is used.

If there exists a stumbling-block or hindrance to distillation, it is without contradiction when the apparatus Prime, that is to say, when the wine subjected to distillation comes over mixed with the alcohol, and flows from the pipe which should ordinarily only deliver the latter. This inconvenience takes place in a great number of apparatuses at the least blast of the fire, or under the influence of a little too much wine. We are compelled then to arrest the operation to interrupt the distilling, and for this purpose smother the fire, draw off a part of the wine not exhausted, and rearrange the apparatus as before in a proper state for working properly. This requires more or less time, which, if the accident is repeated, occasions delays in the operation,
and leads to a disturbance of the general workings of a distillery.

In the new apparatus of M. Egrot all these difficulties have been obviated. If there is an excess of heat produced either by the open fire or by steam, the distillate will be of lower degree than usual, but the apparatus does not prime; we can then, when this lowering of the strength is observed, at once re-establish the equilibrium, disturbed for the moment, and consequently avoid all those annoyances and delays we have just pointed out.

With this apparatus may be distilled all wines and fermented liquids derived from any source, and semifluid materials when the apparatus is of sufficient size.

The product obtained, whether as brandy or alcohol, is peculiarly fine. The apparatus distilling from 10 to 300 hectolitres may be heated either by steam or open fire; those which exceed these dimensions must be heated by steam.

All the pieces of this apparatus are of copper, the flush-couplings of iron, the cocks and connecting-nuts and pipes of bronze.

Description of the Apparatus.—This new apparatus is composed of the following parts:—

- **a.** Copper still.
- **b.** Siphon for the continuous exit of waste liquor.
- **c.** Waste pipe for completely emptying the still when necessary.
- **d.** Opening for cleaning the boiler, closed by a plug.
- **e, f, g, h.** Brickwork of the furnace.
- **i.** Fireplace.
- **j.** Grate.
- **k.** Ash-pit.
- **l.** Flue. *Note—when steam is used—the furnace is replaced by brickwork.*

- **A.** Distilling column composed of plates for continuous distilling.
- **B.** Cap covering the last distilling plate and supporting the rectifying column.
- **D.** Rectifying column.

---

E. Goose-neck conducting the alcoholic vapor to the rectifying coil of the wine-heater.

F. Jacket containing the rectifying coil, and acting as wine-heater.

G. Jacket inclosing the cooling worm.

I. Exit of the cooling worm.

J. Funnel to receive the wine and convey it to the bottom of the wine-heater.

K. Pipe to convey the wine from the wine-heater to the first plate.

N. Pipes and cocks for returning the low wines into the rectifying column D.

R. Regulating bucket.

S. Ball float.

T. Regulating cock with an index to guide the distiller.

V. Pipe to convey the spirits to the proof bottle.

Y. Proof bottle—improved pattern.

Y. Pump.

Z. Wine Vat.

To Work the Apparatus.—To put this apparatus in operation it is sufficient to fill the vat Z with wine or other liquor that is to be distilled, by means of the pump Y, then open the cock T, which permits the wine to flow into the cooler G, the wine-heater F, and the distilling plates A, taking care that the wine does not run into the still a.

When the apparatus is to work over the naked fire, the still a is filled with water* by introducing it through the plug d, and the fire started; the water of the still begins to boil, and the steam which it furnishes passes through each of the distilling plates A, depriving their contents of its alcohol; from this the alcoholic vapors pass into the rectifying column D, where they deposit their impurities, then pass by the tube E into the rectifying coil contained in the jacket F; finally the alco-

* When the apparatus is heated by steam from a boiler, the precaution of commencing the distillation with water is unnecessary; the still may be filled with wine as the other parts of the apparatus.
holic vapor, after being more or less rectified in the coil according to the will of the manager, passes into the cooling coil contained in the jacket \( G \), to pass out in a liquid state at \( I \), and to be received in the proof bottle \( V \), in which there is an alcoholometer to mark the strength or degree of the brandy or alcohol as it comes over.

The wine moves in the opposite direction. It is introduced into the apparatus by opening the index cock \( T \); the funnel \( J \) which receives it conducts it to the bottom of the jacket \( G \), pushing forward the liquid contained in the jackets \( G \) and \( F \); it leaves the upper part of the wine-heater by the tube \( K \), which directs it to the first distilling plate of \( A \), when, after having circulated in the galleries, it is preable in succession over the plates below, then falls into the boiler, whence it escapes by the waste siphon \( b \) as speut liquor, completely exhausted of alcohol.

The wine in traversing the interior galleries of which the plates \( A \) are composed, comes in contact with a great number of small pipes, which forcibly distribute the vapor in the course of the distillation, and agitate the wine without ceasing, thus causing the latter to be easily freed from the alcohol it contains; it is also to this new arrangement that the good quality and delicacy of the products obtained from this apparatus are due.

This fact is easy of explanation if it is remembered that the wine to be completely exhausted does not remain in the apparatus longer than ten or fifteen minutes; it is subjected for a very short time to the action of the heat, and the empyreumatic oils and bad flavor cannot be formed nor pass over with the distillate.

The principal advantages of this apparatus are:

1. Facility of setting up.—Economy of Removal and Transportation.—The small size and great simplicity of construction of which it admits renders the setting up very easy.

The adjustment of the two principal pieces, the still and the condensing wine-heater, is very convenient, both being placed vertically on a foundation easily constructed; the connecting pipes being few in number are readily fitted. Its small size requires but little space, and consequently the cost of packing is relatively less, and the expense of carriage trifling if to be moved to a distance.

2. Remarkable Economy of Fuel.—In consequence of its small dimensions, it affords less surface and does not give out as sheer loss the caloric previously absorbed by distillation. It is a fact, that the larger the apparatus, the greater will be the expense of fuel necessary to work it. The economy of fuel lies too in the peculiar construction of the plates. During the course of the distillation, the vapor being forcibly distributed, is brought in direct contact with the circulating wine, which it agitates freely, from which results a forced ebullition, setting free all the alcohol contained in the liquid.

3. Facility of Use.—Being composed of only three or five plates, according to the alcoholic richness of the wine, the distillation is effected without pressure, consequently without disturbance, and without fear that the apparatus will prime, that is to say, the wine raised by an accumulation of steam or foam will not pass over instead of the alcohol. This stumbling-block in most apparatuses is completely avoided in this; there never being a sufficient quantity of wine in course of distillation, and it is too rapidly exhausted for foam to be formed and obstruct the channels.

4. Richness in Degree.—By reason of the rectifying column placed on the distilling column, and the return of the low wines, the alcoholic degree may acquire a remarkable strength, and the spirit come over at from 70 to 92 degrees, especially when wines are operated on. Moreover, the alcoholic strength is under control and may be fixed at the option of the distiller.

5. Moderate Price.—A question of prime importance is the cost, which is considerably reduced and the difference is greatest for the apparatus of large dimensions. This difference in price naturally depends on the smallness of size which requires less material, without in any degree affecting the solidity of the parts.
6. Simplicity of Cleaning.—In order that an apparatus may be well suited for use, it should be easy to clean. In this, if of small dimensions, it is sufficient to remove the three or five plates, and if of large dimensions, to open the manholes and wash out the interior thoroughly. If this cleaning is repeated every two months, the apparatus will be in the best condition to furnish excellent products. The wine-heater has at its lower extremity a screw plug, which facilitates the removal of any deposit collected at the bottom. The still has also an opening through which it may be washed out; all the coils are mounted in their jackets by joints, so that in the event of cleansing of these coils, as when it is desired to remove the tartrous crust which surrounds them and interferes with the action of the coolers, they may be removed from their jackets without having recourse to the tinner and his solder.

This apparatus may be rendered complete by the addition of the following pieces:

1. In some countries, and particularly in Spain, where very rich wines are distilled, it is common to obtain, at the first distillation, spirits of a very high degree, exceeding 90° cent. In this event it is necessary to add a rectifying cap, which should surmount the rectifying column, which, by its peculiar arrangement, refines and increases the strength of the spirits.

2. When wines or other fermented liquors which are intended for the still, are highly spirituous, i.e., exceed ten or twelve per cent. of alcohol, it may become necessary to use an additional plate, to insure the complete exhaustion of the waste liquor.

3. A pump is indispensable for raising the liquor into the vat. The Eureka Pump Company of New York, under the management of a highly intelligent and accomplished superintendent, manufacture a pump, either of iron or bronze, which is peculiarly well adapted for the use of the distiller.

By the particular arrangement of the valves it cannot be obstructed, even by solid substances of much greater size than would be found in a distiller's vats.
DISTILLATION OF ALCOHOL.

J. Bent pipe, connecting the coil of the wine-heater with that of the cooler.

K. Point of entrance for cold water into the cooler.

L. Point of exit for warm water from the cooler.

M. Extremity of the coil from which the distillate is received.

To Set going and Use the Belgian Apparatus.—Let the wine run through the feed pipe until it fills the two divisions of the wine-heater, then by passing through the tube descends into the distilling column, A. When the liquor has reached the top of the level pipe F, which is known by means of a glass indicator placed at the bottom of the apparatus, the cock of delivery is to be closed, and the cooler D filled with cold water; it is necessary to leave open the cock of the level pipe while the wine is falling through the column, to allow the escape of the air, which is pushed before the descending liquor.

When these arrangements are completed, close the level cock F, and open the steam cock E. This cock is in communication with a steam generator, by means of a copper pipe; the steam is discharged directly into the liquor, and sets it to boiling; the plates are heated in succession, the alcoholic vapors traverse them, being charged more and more, and pass through the Goose-neck B, into the wine-heater CC', where they are finally condensed, then descend into the coil of the cooler D, where the condensation is finally completed. As soon as the spirit begins to flow from the pipe M, turn on wine through the feed pipe, in a quantity proportional to the capacity of the still, and open the cock F so as to permit the spent liquor to escape through the level pipe. The wine, after a sojourn in the wine-heater, becomes heated, circulates in each of the plates in succession, falling from one to the other, and reaches the bottom of the still completely exhausted, whence it flows of itself, and continuously through the level pipe F. From this point care must be taken to keep up an equable temperature, in order to maintain perfect regularity in the progress of the distillation.

APPARATUS FOR DISTILLING SEMIFLUID MATERIALS.

A Belgian still, five meters high and twenty meters in diameter, will distil from 800 to 1000 hectolitres of fermented liquor in twenty-four hours.

Apparatus for Distilling Pasty or Semifluid Materials.

The invention of this apparatus is also due to Cellier-Blumenthal. With it may be distilled raw potatoes, artichokes, grain, &c. As may be seen, Figs. 4 and 5, Pl. IV., it differs but little, very little, from the preceding, which, by the addition of an agitator, can be used for distilling pasty liquids, and replace this, of which the following is a description:—

A. Distilling column, consisting of twelve sections, each containing a plate.

B. Forwarding tub, or wine-heater, for heating the materials to be distilled, by means of the alcoholic vapor from the distilling column, this vessel inclosing a coil as well as an agitator, which is set in motion by gearing fixed on the shafts p and r.

C. Cooler for water, inclosing a large coil.

D. Pump for feeding the wine-heater.

e. Spherical foam arrester, containing a diaphragm on which the foam is broken in the event of any sudden increase of the heat.

f. Goose-neck, conducting the alcoholic vapor into the coil of the wine-heater.

g. Connecting pipe between the coil of the wine-heater and the water-cooler.

h. Discharge pipe for the distillate.

i. Proof bottle, covered by the glass bell j, in which is placed an alcoholometer for testing the strength of the spirit as it flows from the still.

k. Funnel and pipe, to receive the materials from the pump D, and deliver them into the wine-heater.

l. Tube, for conveying the materials to be distilled, from the wine-heater into the still.

m. Steam pipe, for heating the apparatus.

n. Pipe to supply cold water to the slack tub C.
DISTILLATION OF ALCOHOL.

do. Level pipe, for carrying off hot water from the cooler.
p. Vertical shaft of the agitator, of iron, for forcibly stirring the materials in the wine-heater, to prevent them from settling on the bottom of the vessel.
q. Gearing, by which the motion of the shaft r is transmitted to the vertical shaft p.
r-s. Crank, for communicating motion to the pump D, and the agitation of the vat C.
t. Large screw plugs, for cleaning the plates of the distilling columns.
u. Pipes, for pouring the materials from one plate upon the next, when the level rises above the level of these pipes.
v. Spherical caps for discharging the alcoholic vapors into the materials contained in the plates.
x. Tubes, through which the steam passes from one plate to the other; these tubes may be screwed in for convenience of moving at will.
y. Basin, for receiving the exhausted materials. This piece is so arranged that the steam passes freely between it and the walls of the column.
z. First plunging or safety pipe, for the discharge of the exhausted materials.
z'. Second safety pipe, for discharging the exhausted mass from the still.

Method of Using the Apparatus.—The semifluid matters are transferred to the vat C, by means of the pump D, at the same time the agitator is set in motion. When the forwarding tub (wine-heater) is full, the semifluid mass passes through the tube x, spreads over the plates of distilling column A, and after passing through the pipes u, falls into the basin y, and thence into the bottom of the still. When this arrangement is complete, the steam is turned on by the pipe m. This steam being direct, that is to say, moist, there is very soon a sufficient quantity of water produced by the condensation, to prevent the mass from being too thick. As soon as the ebullition is established, the alcoholic vapor passes successively into each plate through the tubes with spherical caps v, and by its action on the liquid, it is more and more charged with alcohol. After having traversed the column, the vapor is passed into the coil of the heater b, through the goose-neck f, where it gives off most of its heat to the material contained in the vat, and from this passes into the cooling coil c, where it is condensed into a liquid.

When the spirit begins to flow, the pump is again set in motion, to maintain the supply of materials. The more solid parts are kept in suspension in the heating vat, by means of the agitator p, and fall on the plates of the still. The alcoholic vapors thin the mass more and more, in proportion as it passes to the lower plates.

When the mass arrives at the basin y, it is completely exhausted, and discharges itself through the safety pipes z and z'.

RECTIFYING APPARATUS.

There is scarcely any difference of form between this and Ronsier's still. Indeed, the latter will answer perfectly for rectifying, by suppressing the first boiler, replacing the plates of wire cloth by solid plates. Nevertheless, manufacturing and country distillers prefer an apparatus specially adapted to rectification.

The following is a description of the apparatus exhibited in Figs. 1 and 2, Pl. V.

A. Still.
B. Column, containing twenty plates a, and twenty-four level pipes b.
C and D. Small cap and pipe, to conduct the alcoholic vapors into the condenser.
E. Condenser, inclosing a horizontal coil c, which is preceded by the lenticular vessels d d', each containing a vertical partition.
F. Pipe, conducting the vapors into the cooler.
G. Cooler, containing a vertical coil.
H. External return pipe, serving to convey the condensed vapors to the plates of the column (another return pipe is placed within the condenser, and commun-
cates with the external pipe, by means of the little tube $g, g'$.

I. Cock on the return pipe, by which it may be ascertained if the return of the condensed spirit goes on properly.

J and K. Pipe and cock, by which the water of the condenser may be emptied on the plates.

L and M. Cap and pipe, through which the water passes from the cooler into the condenser.

N. Level pipe, through which the hot water flows from the condenser.

O. Waste cock to the cooler.

P, P'. Air holes.

Q. Waste cock of the still.

R. Glass indicator, to mark the level of the liquid in the still.

S, S'. cocks of the indicator.

T. Gauge showing the pressure existing in the still.

U. Man-hole for cleaning out the still.

V. Cock for filling the still with the low wines to be rectified.

The method of starting and using this still will be explained under the head of rectification.

Apparatus for Distilling Rum.

The arrangement of this still is due to M. Egrot. Its use and management are simple and easy, and it is much used in the French and English colonies and in Cuba.

The apparatus is made of tinned copper, and consists of the following pieces, Fig. 3, Plate V.

A. Still which is to be filled to two-thirds.

B. Rectifying cap through which the alcoholic vapors pass, and where they lose a portion of their essential oils.

C. Wine-heater, or forwarding vat, inclosing a coil through which the vapors pass into the cooler by the pipe $h$.

D. Cooler, containing a coil. (There is nothing peculiar about this piece.)

d. Waste pipe and cock to the still.

e. Goose-neck, conducting the vapors from the rectifying cap to the coil of the forwarding vat.

f. Pipe and cock for emptying the contents of the wine-heater into the still at the termination of the operation.

g. Return pipe.

h. Pipe connecting the coil.

i. Mouth of the cooling coil from which the spirits pass off.

j. Funnel through which cold water is conveyed to the bottom of the cooler.

k. Level pipe by which the hot water escapes from the cooler, as it is replaced by cold water from the funnel.

m. Pipe and cock for conveying cold water into the cap.

B. (The water passes first through a small funnel pierced with holes which surround the pipe $e$, and after passing through a spiral (snail), contained in the cap, passes off at a temperature of about $60^\circ$ through the level pipe $n$.)

As a general thing in rum factories, the wine-heater is omitted; only the more intelligent planters use it. By this means they take advantage of a part of the heat arising from the distillation, and by this, much hasten the heating of the liquid to be distilled.

The use and management of this apparatus are the same as for the simple still. Care should be taken to keep up the supply of cold water to the cooler, in order to prevent the rum from passing over in the form of vapor.

A description of several other stills for special products and purposes will be given in the body of the work.

Machines and Utensils Necessary for a Distillery.

The machines and utensils for preparing vegetable substances for the vinous fermentation, or necessary for the distillation of alcohol, are of various kinds, according to the nature of the substances to be treated. We shall rapidly pass in review those that are in some measure indispensable to the greater part of these preparations.
The Washer.—Is used for removing dirt, &c., from the roots and tubers employed by the distiller.

The Rasp.—The character of this instrument is of very great importance in a distillery, for it may cause a variation of a fifth in the product. The machine should combine rapidity of motion with a perfect triturating.

The Root Cutter or Slicer.—This instrument is used for slicing roots which are to be treated by maceration. A root cutter, by whatsoever power it is driven, should have a velocity of 130 or 150 revolutions a minute to do its work satisfactorily and well.

The Hydraulic Press.—For extracting thin juice from the pulp of roots, or wine from the pressed of the grape, cider from pumice, &c.; it has, by its superior properties, superseded almost all other means of obtaining pressure among intelligent manufacturers.

The Steam Press.—This press is but little used except in large distilleries. It is very expeditious, and considerably hastens the work, but it is necessary that the sacks, which have been submitted to its action, should also be subjected to the action of the hydraulic press; for the pressure by steam is made almost instantaneously, and we can obtain by it only 60 or 65 per cent. of juice from rasped beets.

The Vat for the Conversion of Starch into Sugar.—When starchy materials are treated on a large scale, solid oaken vats, Fig. 2, Pl. VI., are used from 8 to 10 centimeters thick, and of sufficient capacity to contain 125 hectolitres up to the line a, a'. Vats with much thinner walls may be used, but it is necessary to line them with sheet lead to obviate the carbonizing effect of the sulphuric acid.

b, b', b''. Lead pipe bent into a circle near the bottom of the vat. The circular portion, b', b'', is split at short distances to allow the steam to escape into the liquid contents of the vat. This pipe is connected to a copper steam pipe.

d. Funnel through which the dissolved starch is added in small quantities at a time.

e. Flue for conducting the vapors from the vat to the stack of the chimney.

f. Man-hole through which lime is admitted for the saturation of the sulphuric acid, and for removing the deposit, and washing the vat.

g. Cock placed 15 centimeters from the bottom of the vat for drawing off the clear liquid only.

h. Plug placed at the bottom for emptying the vat entirely.

Macerators.—The process of extracting the saccharine principle from vegetable substances is effected by many arrangements of apparatus of more or less value. In speaking of the manufacture of alcohol from the beet, we shall describe those processes only which appear to be best adapted to the wants of the distillery.

Elevator.—This name is applied to a small iron cylinder shaped like a boiler, generally used in sugar factories and refineries for raising the juice or syrup to the different stories of the building, by means of steam pressure. The elevator replaces the pump very advantageously; a few minutes are sufficient for raising 10 hectolitres to a height of 20 or 25 meters, and even more. Its use is a source of economy and expedition; we therefore employ it constantly, even in small country distilleries where steam is used.

The following is a description of this interesting and remarkably simple apparatus, with its accompanying tank, Fig. 3 and 4, Pl. VI.

A. Elevator.—Cylinder of iron plate, having hemispherical heads, and capable of bearing the same pressure as the steam generator. It should be tested for the same number of atmospheres.

B. Tank for receiving the liquid to be raised.

c. Cock for ascertaining when there is a sufficient quantity of liquid in the elevator.

d. Steam cock.

e. Cock for the escape of air, to facilitate the entrance of the liquid.
DISTILLATION OF ALCOHOL.

80

g. Three-way cock, by which the liquid may be directed to different places.

h. Tube rising from the bottom of the elevator for conveying the liquid to the three-way cock in its ascent.

t. Man-hole for repairs and cleaning.

To Use the Apparatus.—First open the air cock f, to allow the air to escape, then open the cock b, in order that the liquid may flow into the elevator. When the liquid rises to the level of the cock c, close the cocks f and b, turn the key of the three-way cock g towards the pipe by which the liquid is to be raised, and open the steam cock d; the steam will fill the vacant space and press on the surface of the liquid. This will yield and rise promptly by the inner tube h, and pass to its destination without leaving the smallest quantity in the apparatus. The progress of the operation may be followed up by placing the hand on the pipe through which the liquid is passing. As soon as the heat becomes too great to be borne, it is certain that there is no more liquid in the elevator.

Another method is sometimes adopted for using the elevator, as follows: Open the three-way cock g upon any pipe, taking care to close the cocks b, c, and f; open the air cock d, in order that the steam may completely expel the air from the vessel; this may be known when the cock by which the air is escaping is too hot to bear the hand; at this moment close first the cock c, then d, the steam will condense and cause a vacuum in the apparatus; then, after two or three minutes, open the cock b only; the liquid is drawn rapidly into the elevator; at this stage close the cock b, turn the key towards the pipe through which the liquid is to be raised, and open the cock d.

When through inattention the elevator is entirely filled with liquid, it is impossible to make it operate; the steam, by the loud clapping produced by its condensation, announces this accident, which is easy enough to remedy. For this purpose, open the cock b, when the steam presses the liquid back into the tank B, and, as soon as a proper quantity has been drawn off, close the cock b; there being now space enough for the steam to press properly on the liquid, the operation will go on properly.

Pumps.—Two kinds of pumps are used in distilleries; one for liquids, when there is no elevator, and the other for semi-fluid materials. The former should be a forcing and suction pump, and should occupy but little space. The Eureka pump made in New York, besides combining these properties, is cheap, and requires but little force to work it.

The second, called the movable tube pump, has the advantage of having no piston, and not being liable to choke; it raises pasty substances as well as hot or cold liquids. There is in this pump no cause of derangement, the only part which must be cared for is the piece of leather that is in the movable tube: all delays are prevented by having extra leathers in case of accident.

Filters.—It frequently happens that clear liquids have to be separated from deposits which have formed, or from substances held in suspension; it is necessary that the distiller should have a number of filters at hand. They may be made of cloth stretched on frames; but those which appear to be most convenient consist of large baskets lined with woollen cloth. The liquid to be filtered is poured into these lined baskets. The liquid passes through while the grosser matters are retained.

Besides the machines and utensils just described, there are many others which are necessary to the distiller, and which it is only necessary to record by name. They are, for the wine distiller, grape-pickers, postles, and presses; for the grain distiller vats for steeping, and germinating-kins, mills for crushing or grinding grain, vats with a double bottom, and boilers for starch, flour, &c.

Some utensils of daily use are indispensable, as wooden rakes, shovels and skimmers, iron forks, siphons of tin, lead, or gutta percha, spirit-pumps, wine-testers, tin pans and measures, wooden buckets, faucets of various sizes, large funnels of tin and wood, deep wooden tubs, beaters, tampers, &c.