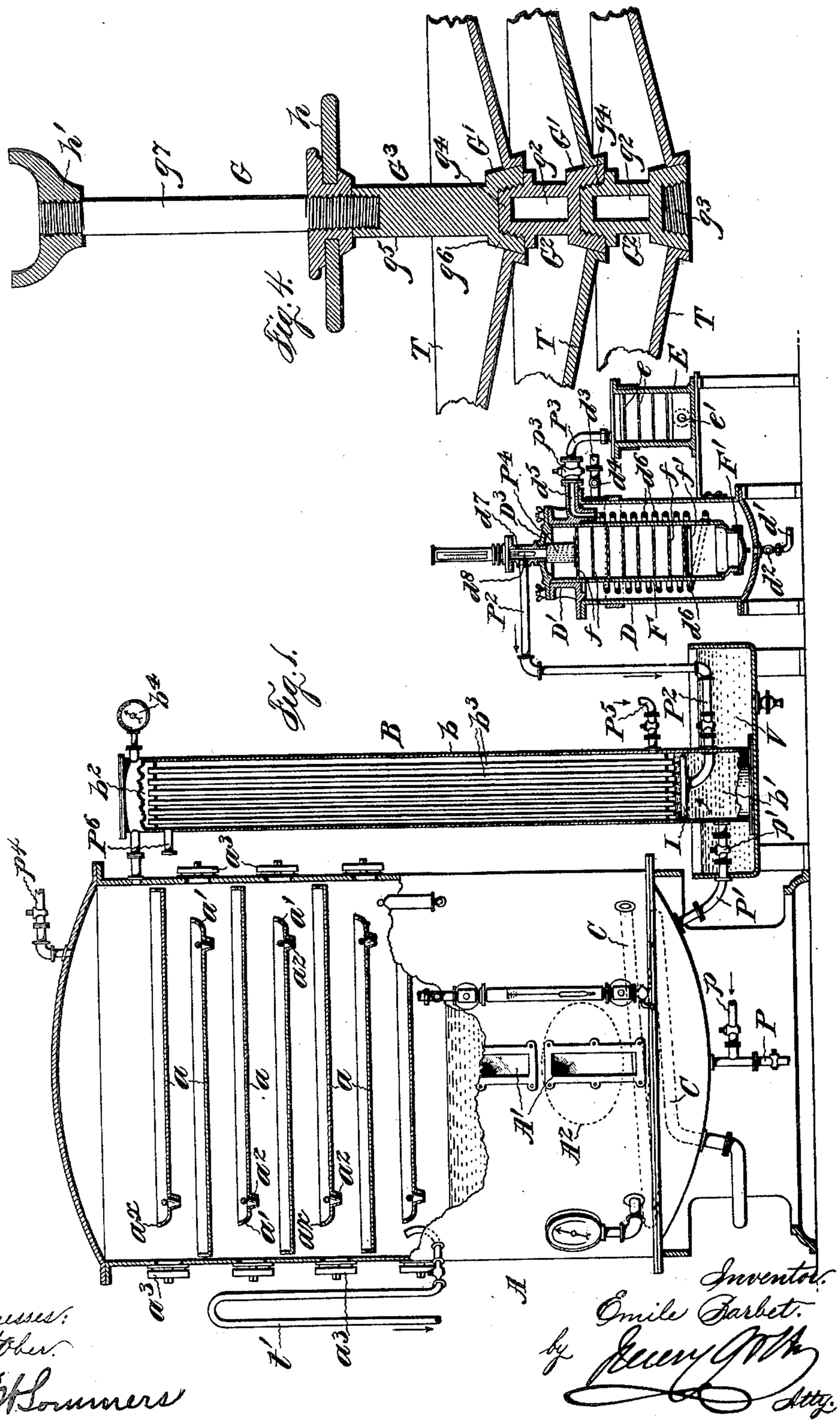
No. 668,080. Patented Feb. 12, 1901.

E. BARBET.

APPARATUS FOR MANUFACTURING YEAST.

(Application filed Nov. 21, 1899.)

(No Model.) 2 Sheets—Sheet 1.



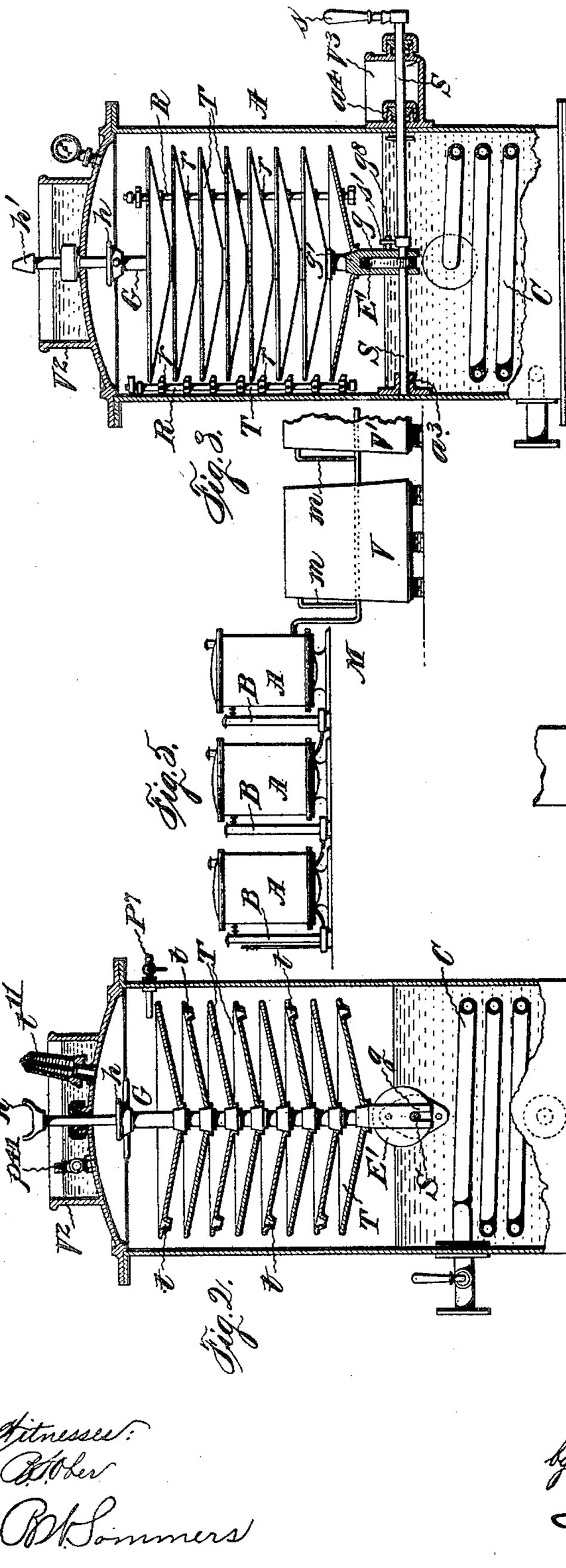
No. 668,080. Patented Feb. 12, 1901.

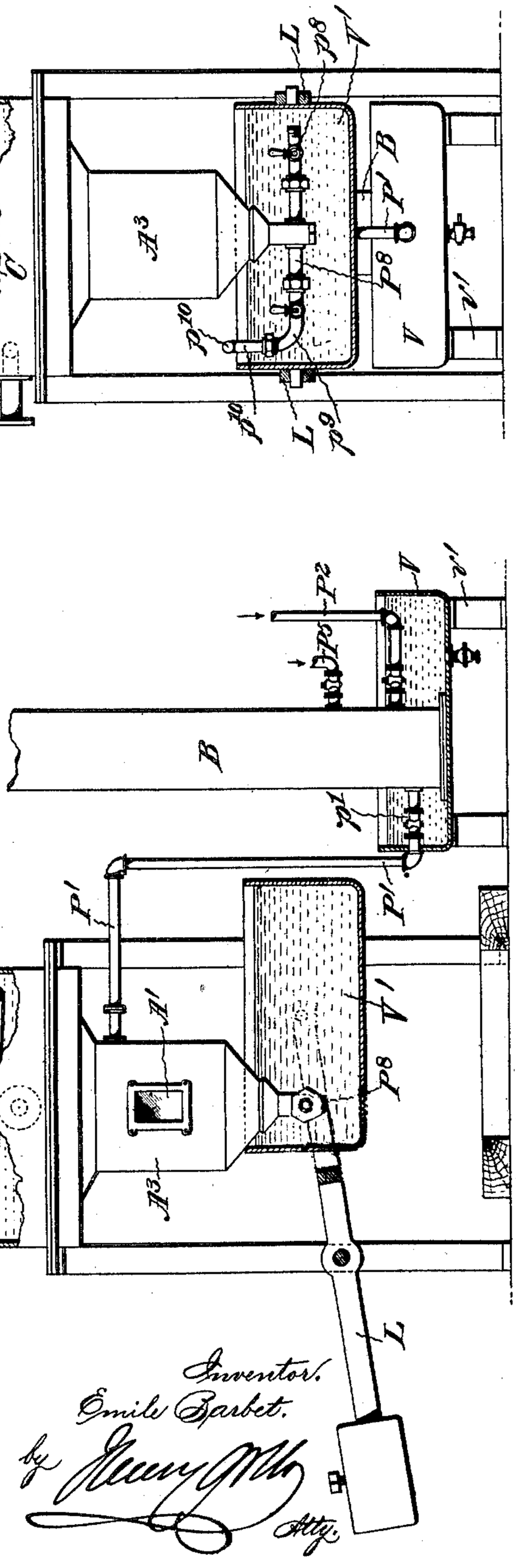
E. BARBET.

APPARATUS FOR MANUFACTURING YEAST.

(Application filed Nov. 21, 1899.)

(No Model.) 2 Sheets—Sheet 2.





Witnesses:
B. O. Orr
R. L. Sommers

Inventor:
Emile Barbet.
by Munn & Co
Atty.

UNITED STATES PATENT OFFICE.

EMILE BARBET, OF PARIS, FRANCE.

APPARATUS FOR MANUFACTURING YEAST.

SPECIFICATION forming part of Letters Patent No. 668,080, dated February 12, 1901.

Application filed November 21, 1899. Serial No. 737,776. (No model.)

To all whom it may concern:

Be it known that I, EMILE BARBET, a citizen of France, residing at Paris, France, have invented certain new and useful Improvements in the Manufacture of Pure Ferments, such as Distillers' and Brewers' Yeast; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

My invention has relation to the manufacture of pure ferments, such as distillers' and brewers' yeast.

In the manufacture of ferments the aeration of the cultures is, as practice has demonstrated, one of the most important factors, it being of course assumed that the propagation is effected under absolutely aseptic conditions in so far as contamination of the culture by foreign microbes is concerned. It is not an easy matter, for instance, to aerate the culture in an industrial vat of considerable capacity where the air must be distributed throughout the body of the liquid in which the ferment is to be propagated. This has hitherto been effected by means of pipes arranged in the bottom of the vat and having numerous fine perforations, the sterilized air being supplied to said pipes under pressure. I have found that in practice all of these fine perforations are not available, because the air, unless under a pressure which is not conducive to the uniform and rapid propagation of the ferment, will issue from the perforations of the pipe or pipes at certain points rather than at others, and however small these perforations may be it is impossible to avoid the union of the small bubbles of air into large spherical bubbles, whose action upon the spores is very limited, while if the perforations in the pipes are very small there is always danger of their becoming choked up, so that in practice it has become necessary to inject from fifty to one hundred times the quantity of air theoretically necessary to the propagation of the ferment. The air which acts upon the ferment-cell is especially the dissolved air and when brought into contact with a thin stratum or film of liquid under cultivation its action is not the same as when the air is forced into a body of such liquid. A striking proof of this is found in the cultivation of the amylomices Rouxii, the mucedineæ showing different aspects according as they are cultivated in a film by superficial aeration or by immersion, in which latter process great volumes of air must be injected into the body of the wort, as is the case in some of the later processes of fermentation, because the action of the air on the fungi or germs is far less effective than in film culture. Furthermore, in the propagation of yeast-cells the surface aeration tends to greatly increase the activity of the cells, even more so than in the similar cultivation of mucedineæ, as has been proven by Pasteur, so that the large quantities of yeast usually required can be materially reduced.

The object of this invention is to apply this kind of aerobiosis to the manufacture of pure yeast; and it consists, essentially, in the apparatuses employed and in the combination of apparatuses whereby the manufacture may be carried out continuously; but that my invention may be fully understood I will describe the same in detail, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical sectional elevation of an apparatus embodying my invention. Figs. 2 and 3 are similar views, the sections being taken in planes at right angles to each other, illustrating a modified construction of propagating vessel. Fig. 4 is a sectional detail view, drawn to an enlarged scale, showing the upper section and one of the intermediate sections of the shaft G, Figs. 2 and 3; and Fig. 5 is an elevation illustrating a plant suitable to the continuous manufacture of yeast.

In the manufacture of pure ferments it is essential that the apparatuses used should be of such a construction as to be readily sterilized and that the cultivation and propagation may be carried out aseptically—that is to say, under exclusion of all microbes or germs other than the ferment germ to be cultivated and propagated.

In Fig. 1, A indicates the propagating vessel, adapted to be hermetically closed and provided in its upper portion with a series of shelves *a*, preferably of copper, extending alternately from one side of the vessel nearly

to the opposite side to form a zigzag passage, so that the liquid fed to the upper shelf will flow from the same onto the shelf next below, and so on over all the shelves successively. The shelves have upturned free edges, a portion of which opposite to the inflow of liquid and air being serrated or dentilated, as shown at $a^{\times}$, to form overflow-channels of such depth as to maintain upon said shelves a comparatively thin layer or film of liquid and to maintain the latter as long as possible in contact with the air sweeping over the shelves before such liquid flows from one shelf to another.

At or near the upturned outer edge the shelves a are provided with a discharge-opening normally closed by a stopper a^2, the vessel A being provided with hand-holes through which access may be had to said stoppers and through which a hose may be introduced for the purpose of cleansing the shelves, said hand-holes being normally closed by a cover a^3.

In the lower part of the vessel A is arranged a coil of pipe C, and above the convex bottom of said vessel are two glazed openings A′ for observing the progress of the propagation, and said vessel is also provided with a manhole A^2 (shown in dotted lines in Fig. 1) for obvious purposes. The vessel A is further provided with temperature and pressure indicators, as usual, with a seeding-tube t', a feed-pipe p^4 in the upper head provided with a stop-cock for charging the vessel with a suitable propagating liquid, and with a branched pipe P and a pipe P′ in its lower head, said pipe P and its branch p, as well as the pipe P′, each being provided with a stop-cock.

The pipe P′ is connected with the receiving-chamber of a pneumatic liquid-raising apparatus B for raising the liquid under cultivation from the lower part of vessel A to the upper one of the series of shelves a therein.

The apparatus B is of well-known construction, and consists, essentially, of a casing b, divided by tube-sheets into a lower receiving-chamber b' and an upper delivery-chamber b^2, provided with a temperature-indicator b^4. In the tube-sheets are secured the open-ended raising-tubes b^3, the number of which depends upon the capacity of the vessel, and in said receiving-chamber b' is arranged the air-injector I, having a nozzle in line with and for each of said tubes, said injector being connected by a pipe P^2, provided with a stop-cock, with an air-filter, presently to be described.

By means of the pneumatic liquid-raising apparatus wherein the liquid is raised by the ascensional property of the air, small volumes of liquid alternating with air-bubbles, I not only raise the liquid, as described, but at the same time supply the necessary air in a subdivided condition, which air moves along with the liquid and as it is liberated on the shelves acts upon the surface of such liquid on all the shelves, finally escaping through the tube t' and carrying with it the carbonic-acid gas generated by fermentation, which acid may be collected and freed from air and liquefied if desired for use.

It is obvious that with a pneumatic apparatus B constructed as described it is possible to either heat or cool the liquid raised to any desired temperature by admitting a heating or a cooling agent through the pipe P^5 and exhausting it through pipe P^6.

As hereinbefore stated, the pipe P^2 of the air-injector is connected with an air-filter F, contained in a casing D of the required strength to sustain the necessary pressure to which it is subjected for sterilizing purposes. The casing D has in its lower head a pipe d', provided with a stop-cock d^2, and near its upper end a pipe d^3, provided with a stop-cock d^4. To the upper head D′ is secured the filter F, and in said head D′ is formed an air-passage d^5, to the inlet end of which the air supply or feed pipe P^3, provided with a stop-cock p^3, is secured. To the inner or outlet end of passage d^5 is connected one end of a coil of pipe d^6, whose opposite end is connected with the filter F near its lower end. The head D′ of casing D is closed by a cover D^3, having an outlet-pipe d^7, in which is arranged a thermometer d^8, and having a branch connected with the pipe P^2 of the air-injector I of the pneumatic liquid-raising apparatus B.

The air-filter F contains a number of perforated partitions f, the lower one of which rests loosely upon a seat-ring f' or other suitable support, the remaining partitions fitting loosely in the filter-chamber and having layers of cotton-wadding interposed between them. Upon the upper partition f' and having bearing against the cover D^3 and surrounding the inlet to the discharge-pipe d^7 is arranged a perforated pipe P^4, so that when the cover is applied the layers of loose cotton-wadding can be more or less compressed to prevent the air entering the filter from flowing in a more or less direct course through the layers of cotton, which may be the case if in too loose a condition. Furthermore, as the air passes through the several partitions it is divided into more or less fine streams, so that it can be more effectually and completely freed from all noxious germs.

In practice I prefer to use in conjunction with the described filter F a second filter E, wherein the air is preliminarily purified by causing it to pass through several layers of cotton-wadding separated by perforated partitions e, loosely placed on the wadding, the air being forced into this filter below the lower one of the series of partitions e at e' and flowing from the upper part thereof through pipe P^3 and coil d^6 into the lower part of filter F. I am thus enabled to free the air from all solid impurities and also from a great portion of germs held in suspension therein, so that the cotton in the filter F need not be sterilized or removed by reason of an accumulation of solid substances as often as would otherwise be the

case, while such removal can more readily be effected from the small air-filter as often as may be necessary. As shown, access may be had to the filter F through the lower end thereof, which is closed by a screw-cap F'.

With an air-filter F constructed as described, it is not only possible to thoroughly filter or sterilize the air passing therethrough, but also to sterilize the filtering material by means of steam under such pressure as to heat the cotton to a sterilizing temperature—say 150° centigrade—the steam being admitted into casing D through pipe d^3, while the water of condensation is drawn off from time to time through pipe d', by which operation the air-supply coil is also sterilized. It is furthermore possible to raise the normal temperature of the air to that degree most suitable to the culture and propagation of the ferment-cells by means of steam admitted into casing D and maintain the temperature of the air substantially uniform during the process of propagation—*i. e.*, during the process of producing the ferment.

Any liquid suitable to the propagation of ferment-cells can of course be used—as, for instance, a brewer's or distiller's wort—which may be sterilized in the propagating vessel itself by heat from coil C. The wort may, however, be sterilized in a separate vessel and fed to vessel A and cooled to the proper temperature by spraying a cooling agent, as cold water, upon said vessel, the wort being fed thereto through pipe p^4 by any well-known means, with the usual precautions against contamination with noxious germs, a sufficient quantity of the wort being introduced into said vessel to fill the same nearly to the lower one of the series of shelves *a*.

Of course before the vessel A is supplied with wort it is sterilized by means of steam—for instance, by connecting the branch *p* of pipe P with a source of steam-supply under such pressure as to raise the temperature within the vessel to about 150° centigrade. The small amount of steam escaping from pipe *t'*, which is of comparatively small cross-sectional area internally, may be disregarded, especially if superheated steam is used, the water of condensation being afterward drawn off through pipe P. In practice the air-escape pipe *t'* or a portion thereof is preferably flexible, so that during the charging and sterilizing of the vessel A it may be closed—as, for instance, by means of the well-known Mohr clamp. The pneumatic liquid-raising apparatus is also sterilized before the vessel A is charged, to which end hot water can be admitted through pipe P^5 and allowed to flow off through pipe P^6, and the stop-cock p' in pipe P' may also be opened during the sterilization of the vessel A, so that the steam will flow through the tubes *b* of said apparatus.

The usual precautions are taken to prevent access of atmospheric germs through the various stop-cocks, these being immersed in a liquid asepticized by means of formol, as shown in Fig. 1, where the lower part of the pneumatic raising apparatus B is contained in a vessel V containing such asepticised liquid, in which the stop-cocks of the pipes P' and P^2 are also immersed, similar arrangements being provided for the other pipes. In practice the pipe *t'* may be partly metal and partly rubber and may then be closed during sterilization and the drawing off of the ferment and fermented liquor by means of a clamp, as hereinbefore referred to.

From what has been said the operation of the apparatus will need but a brief description.

In practice I first introduce into vessel A through supply-pipe p^4 a part of the quantity of wort, and after closing the stop-cock in said pipe I sow the wort with mucedineæ introduced into vessel A through the seeding-tube *t'*, which is then closed by means of a Mohr clamp, for instance. The stop-cock *p'* in pipe P', which is closed during the described operations, as shown in Fig. 1, is now opened and wort is allowed to flow into B until the injectors I are completely immersed, when the stop-cock in pipe P^2 is opened to admit sterilized air to said injectors, whereby the wort is raised in the tubes of B in the manner hereinbefore described and flows from the upper end of B onto the upper one of the shelves *a* and thence from shelf to shelf, the air supplied sweeping over the thin film of liquid always present on the shelves, the oxygen acting upon the same in a well-known manner. As soon as the pressure in vessel A has risen sufficiently the seeding-tube *t'* is opened, allowing the air and carbonic-acid gas generated by fermentation to escape. As the fermentation or propagation of the mucedineæ proceeds I introduce into vessel A a further portion of the normal charge of wort, and so on until all the wort to be used has been supplied to said vessel A, as I have found that the propagation of the mucedineæ proceeds much more rapidly by the gradual addition of wort. The fermentation—*i. e.*, the propagation of the ferment—proceeds rapidly, and its progress can be observed through the glazed apertures A'. After fermentation ceases the entire charge can be transferred through pipe P to the brewers' or distillers' vat or vats and used for fermenting batches of wort or mash, or the fermented liquid may be separated from the ferment by well-known means and distilled, while the yeast can be used as such or stored in previously-sterilized receptacles, as will be nereinafter referred to, the wort and yeast being drawn off through pipe P, after which the vessel A is again supplied with wort. During the fermentation the deoxygenated air or partly-deoxygenated air is allowed to escape through the seeding-pipe *t'*, together with the carbonic-acid gas evolved, as hereinbefore stated.

In Figs. 2 and 3 I have shown a modified

form of propagating apparatus more especially designed for the production of concentrated ferments—that is to say, an apparatus of such a construction that the ferment may be readily separated from the mother or fermented liquid and put up in suitable vessels, previously sterilized, for market.

The propagating vessel A, which is provided with a heater-coil C, temperature and pressure indicators, an air and carbonic-acid-gas escape-pipe, (not shown,) a seeding-tube t'', and a wort-feed pipe p^{41}, has a lower contracted extension A^3, provided with a glazed aperture A′, for purposes hereinbefore stated, and is connectible at its upper end with the delivery-chamber of a pneumatic liquid-raising apparatus, such as described, through a pipe P^7, which is or may be provided with a stop-cock. At a point near the upper end of the contracted extension A^3 the vessel A is connectible with the receiving-chamber of the aforesaid liquid-raising apparatus through the pipe P′. At its lower end the extension A^3 has a T-pipe P^8, the branches of which are provided with stop-cocks, the branch p^8 being screw-threaded for the application thereto of a rubber discharge-tube, while the branch p^9 of said pipe P^8 is connectible or connected with a branch of the air-feed pipe P^5 by means of a flexible tube p^{10}.

As shown in Figs. 2 and 3, the lower end of the extension A^3 of vessel A, with its pipe P^8, is immersed in a sterilized liquid contained in a vessel V′, for purposes heretofore explained, this being likewise the case with the feed-pipe p^{41} and the seeding-tube t'', which latter is arranged in this case in the upper head of vessel A and immersed in an aseptic liquid contained in vessel V^2 on said head, which latter is removably secured to the vessel A, so that a manhole is dispensed with. The seeding-tube t'' has a valve-casing screwed thereto, the valve in which is held to its seat in the end of said tube by a spring coiled about the valve-stem—an arrangement commonly used in apparatus of the kind for the purpose of preventing access thereto of adventitious micro-organisms during propagation—and as a further safeguard the said tube and valve-case at the point of connection are immersed in an asepticized liquid.

In a suitable bearing a^3 in vessel A is journaled one end of a cross-shaft S, that extends through a suitable stuffing-box bearing a^4 and through a stuffing-box on a vessel V^3, containing an asepticized liquid, said shaft carrying at its outer end a handle s and in the axial plane of the vessel A an eccentric E′, on which is seated the lower bifurcated end g of a vertical shaft G, which bifurcated end also straddles the shaft S. On one side of the bifurcated lower end of the shaft G the shaft S carries a radial pin s', which when the eccentric is in the position shown in the drawings, with its greater diameter above the shaft S, has bearing against a pin g^8, secured to said bifurcated portion. The shaft G extends through the upper head or cover of the vessel A and through a suitable stuffing-box immersed in the asepticized liquid in vessel V^2, said shaft G being a sectional one. It is composed of the lower bifurcated portion g, having a conical externally-threaded head g', intermediate sections G^2, corresponding in number to the number of trays, presently referred to, said intermediate sections consisting of a cylindrical portion g^2, having an internally-threaded conical seat g^3 and an externally-threaded conical head g^4, and of an upper section G^3, having a cylindrical portion g^5, an internally-threaded conical seat g^6, and an upper attenuated portion g^7, provided at its outer end and at the point of junction between the portions g^5 g^7 with cross-handles h' and h, respectively. The outer faces of the cones g^3 and g^6 of the shaft-sections are turned true and serve as bearings for dished circular trays T, provided near and at alternate opposite edges with an overflow-opening t, so that the wort will here also flow to and from one side of one tray to the opposite side of the tray next below, and so on throughout the series, the trays being all of the same diameter.

In bearings on the inner face of the vessel A are revolubly mounted rods R, preferably three, at equal distances apart, each of said rods having secured thereto a number of lugs r equal to the number of trays, said lugs having inclined faces corresponding with the inclined bottoms of the trays. When the rods R are in their normal position, their lugs r lie slightly below their respective trays, so that when the shaft S and its eccentric E′ are revolved to bring the major diameter of said eccentric below said shaft the shaft G will drop. As said shaft G moves down the trays T move with it but a short distance, being held back by the lugs r on the rods R, from which lugs said trays will then be supported, while the shaft G moves sufficiently out of its bearings in the trays. Inasmuch as these bearings, as well as the shaft-journals fitting into the same, taper upwardly, annular openings around the journals of shaft G will be formed when said shaft drops, as will be readily understood, through which openings the material on the trays is discharged into vessel A.

By means of the arrangement of the trays T, their supporting-shaft G, and the revoluble rods R it will readily be seen that if the head of the vessel A is removed, the eccentric E′ on shaft S being in its normal position, Fig. 3, the shaft G supporting the trays, the rods R can readily be turned to move their lugs out of line with their respective trays T, and as shaft G is removably seated on said eccentric E′ said shaft G, together with its trays, can be bodily removed from vessel A.

Inasmuch as the conical seats form close-fitting joints, it is possible that the shaft G may not descend when the eccentric E′ is turned from its position, Figs. 2 and 3, into a reverse position, and to compel said shaft

to move down I provide the pin g^8 on its bifurcated portion and the pin s' on sleeve on shaft S.

The operation of propagating the ferment-cells is substantially the same as described in reference to the apparatus, Fig. 1, except that the ferment will not only settle in the extension A^3 of vessel A, but also in the trays T, and after fermentation is completed the trays are emptied, as set forth. The ferment or yeast is allowed to settle in said extension and is then drawn off into sterilized vessels through branch p^8 of pipe P^8. Should this pipe become choked—that is, should the ferment not be forced out by the pressure of the supernatant liquid—the stop-cock in branch pipe p^9 of pipe P^8 is then quickly opened to admit air-pressure to facilitate the discharge of the ferment, the vessel V' being of course first removed from its supports v', which may be drawn from under it, or said vessel may be hung from a weighted lever L and raised and lowered at will, as shown in Figs. 2 and 3.

The cultivation of ferment can, by means of the construction of the propagating vessel, be made continuous, which is of great importance in the production of ferment for the market or for the brewer and distiller. To this end I employ, as shown in Fig. 5, a battery of propagating vessels A, connected in series by pneumatic lifting apparatuses B, the last of the series of vessels A being connected by pipe M and branch pipes m with two or more fermenting-vats V V', the number of such depending upon the output of the distiller or brewer, or said vats V V', &c., may serve as stock-vats for the ferment, which may be taken thence to the propagating vessel or vessels A A. The process of cultivation is carried on gradually in the battery of vessels A, so that the fermentation of the wort—*i. e.*, the process of propagation—will be completed in the last of the series of vessels A, the wort being continuously fed to the first of said vessels A and transferred, as described, in succession from the lower part of one vessel to the upper part of the next.

In the manufacture of yeast for the market in a concentrated form the last vessel A of the series is preferably of the construction shown in Figs. 2 and 3 for obvious reasons, each of the pneumatic liquid-raising apparatuses B being of course connected with a source of supply of sterilized or filtered air.

Although I have described my invention as more particularly designed for the production of brewers' and distillers' yeast, yet it is obvious that other ferment germs can be cultivated and propagated.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. Apparatus such as described, comprising a propagating vessel, shelves therein constructed and arranged to cause the propagating liquid to flow thereover alternately in opposite directions and to constantly maintain thereon a thin stratum of such liquid, and means for transferring said liquid in successive small quantities from the lower part of the vessel to the upper shelf therein, and for simultaneously conveying sterilized air in successive small quantities with said small quantities of liquid, for the purposes set forth.

2. Apparatus such as described, comprising a propagating vessel, shelves therein constructed and arranged to cause the propagating liquid to flow thereover alternately in opposite directions and to constantly maintain thereon a comparatively thin stratum of liquid, a pneumatic liquid-raising apparatus B such as described, having its receiving-chamber connected with the lower part of the vessel and its delivery-chamber with the upper part thereof, to discharge liquid and air onto the upper shelf, and an air-sterilizer connected with the injector of said raising apparatus, for the purpose set forth.

3. Apparatus such as described, comprising a propagating vessel, shelves therein constructed and arranged to cause the propagating liquid to flow thereover alternately in opposite directions and to constantly maintain thereon a thin stratum of liquid, means in the lower part of the vessel for heating the liquid, a pneumatic liquid-raising apparatus B, such as described, having its receiving-chamber connected with said lower part of the vessel, and its delivery-chamber with the upper part thereof to discharge liquid and air onto the upper shelf; in combination with an air-sterilizer connected with the injector of said apparatus B, and means for preheating the sterilized air, for the purpose set forth.

4. A propagating vessel, superposed shelves therein, each provided with a discharge-opening, plugs for closing said openings and means adapted to be operated from without for shifting the plugs to open and close said discharge-openings, for the purpose set forth.

5. A propagating vessel, superposed shelves therein, each provided with a discharge-opening in line with one another, plugs closing said openings, and means adapted to be operated from without for shifting said plugs simultaneously to open and close their respective discharge-openings, for the purpose set forth.

6. A propagating vessel, superposed shelves therein each provided with a tapering axial discharge-opening, a support common to all the shelves and provided with conical plugs for closing said openings, means for displacing the support vertically to shift the plugs out of or into their respective discharge-openings, and means for preventing the shelves from following the movements of the support in a downward direction, for the purpose set forth.

7. A ferment-propagating vessel, a vertical shaft therein composed of sections detachably connected together, each section provided with a cone-journal, dished shelves provided with an axial bearing fitting said cone-journals, means for raising and lowering the

shaft and means for preventing the shelves from following the downward movements of said shaft, for the purpose set forth.

8. A ferment-propagating vessel having a settling-chamber at its lower end and a T-pipe connected with the lower end of said chamber, the branches of said pipe provided each with stop-cock, superposed dished shelves in the upper part of the vessel having overflow-ports at alternately opposite edges, means operated from without the vessel for emptying said shelves and a shiftable vessel V′ containing an asepticized liquid in which the stop-cocks of the aforesaid T-pipe are immersed, for the purpose set forth.

9. A ferment-propagating vessel having a settling-chamber at its lower end, and a T-pipe connected with the lower end of said chamber, the branches of said pipe provided each with stop-cock, superposed dished shelves in the upper part of the vessel having overflow-ports at alternately opposite edges, and means operated from without the vessel for emptying said shelves; in combination with a pneumatic liquid-raising apparatus B such as described, having its receiving-chamber connected with the upper part of the aforementioned settling-chamber and its delivery-chamber with the upper part of the vessel to discharge liquid and air upon the upper shelf, an air-sterilizer connected with the injector of said apparatus B, and a connection between said sterilizer and one of the branches of the aforesaid T-pipe, for the purpose set forth.

10. In a ferment-propagating apparatus, a plurality of propagating vessels, shelves therein constructed and arranged to cause the propagating liquid to flow from shelf to shelf alternately in opposite directions, means for feeding said liquid to the first vessel of the series, a pneumatic liquid-raising apparatus B such as described, interposed between each two of said vessels and having its receiving-chamber connected with the lower part of one vessel and its delivery-chamber with the upper part of the next succeeding vessel to discharge liquid and air onto the upper shelf therein, a similar apparatus B for the first vessel of the series having its receiving-chamber connected with the lower part and its delivery-chamber with the upper part thereof to discharge the liquid and air onto the upper shelf therein, and one or more storage vessels connected with the lower part of the last fermenting vessel of the battery of such; in combination with means for supplying sterilized air to the injectors of the apparatuses B, for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

EMILE BARBET.

Witnesses:
EDWARD P. MACLEAN,
GEORGE E. LIGHT.