GEORGE GILMAN PERCIVAL.

Improvement in Process and Apparatus for Extracting Essential Oils.

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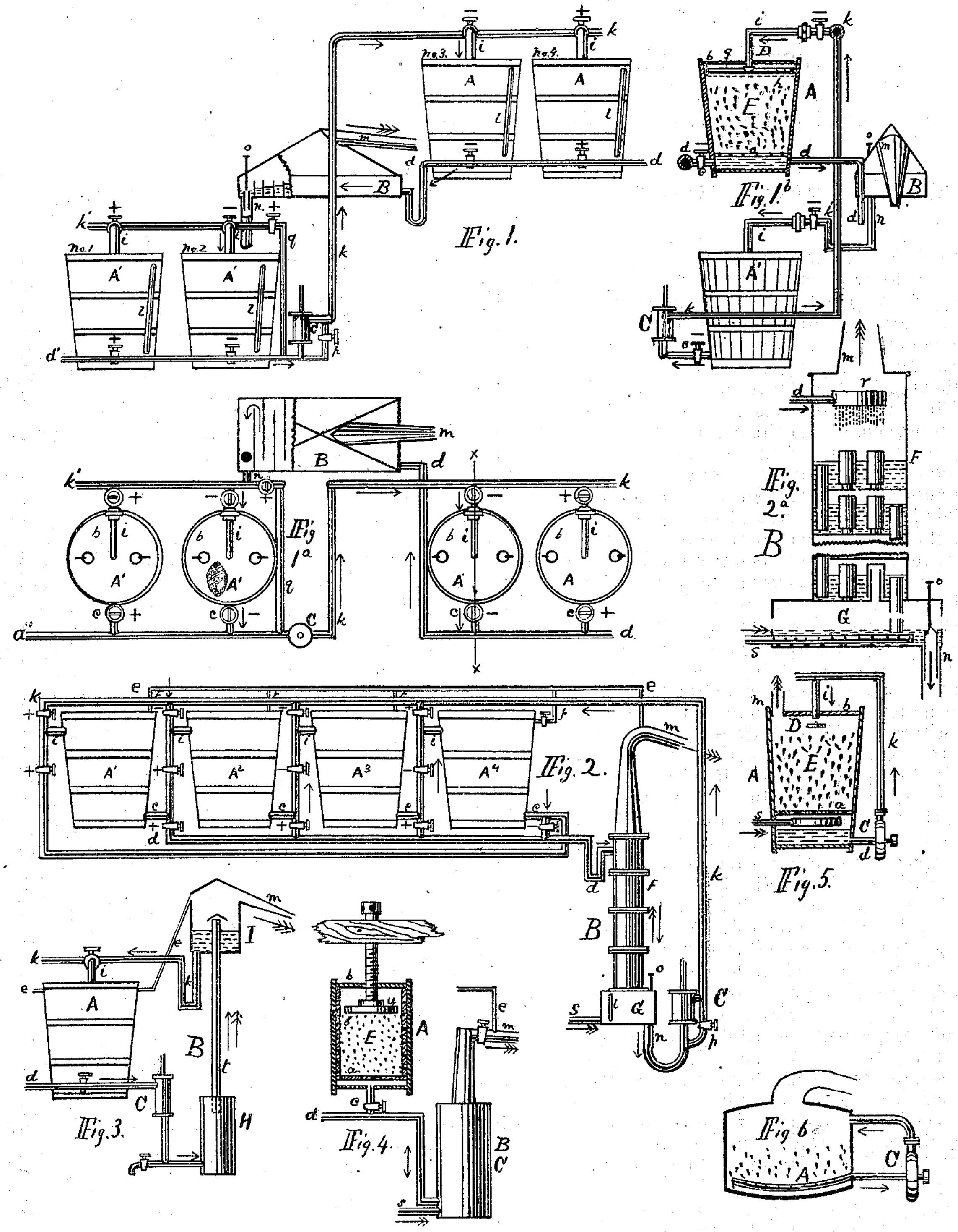

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IMPROVEMENT IN PROCESSES AND APPARATUS FOR EXTRACTING ESSENTIAL OILS.

Specification forming part of Letters Patent No. 120,596, dated November 7, 1871; antedated November 4, 1871.

To all whom it may concern:

Be it known that I, GEORGE GILMAN PERCIVAL, of Waterville, in the county of Kennebec and State of Maine, have invented certain Improvements in the Art or Process and in Apparatus for Extracting Essential Oils, of which the following is a specification.

The first three parts of this invention relate to improvements in the art or process of extracting essential oils; and the other six parts relate to combinations of various mechanical devices for accomplishing the first—thus: First, instead of distilling the oil direct from the charge I transfer the oil from charge to water by percolation, lixiviation, or hot infusion, and then extract the oil from this menstruum by distillation in another apparatus or another part of same apparatus. Second, I produce an artificial circulation of water in the still-body, or increase the natural circulation by pumps, jets of steam, or a *monte-jus*. Third, I cause the water which extracts the oil from charge to extract oil from two or more charges in separate stills each time it is distilled. The fourth part relates to combining a single still-body, or a series of still-bodies for holding charges, with a still for liquids in such a manner that water impregnated with oil in the former may be distilled in the latter. The fifth part relates to combining a pump or *monte-jus* with the last-named combination in such a manner that the pump shall force water through both. The sixth part relates to combining a pump or *monte-jus* with a single still-body, or a series of still-bodies, in such a manner that the pump shall cause or increase currents of water in one or more bodies. The seventh part relates to so combining a series of still-bodies that water must pass through two or more of them each time it passes to liquid-still or oil-extractor. The eighth part relates to the combination of a still and a device for spreading water over top of charge. The ninth part relates to the combination of a still with a boiler with a labyrinthine bottom.

By the first part of this invention I am enabled to perform the act of distillation itself upon a liquid instead of upon a solid, or a solid and liquid together, and in smaller and cheaper vessels, and to use in this distillation many modifications of spirit and other liquid stills which are not applicable to the extraction of oils direct from the solids. I am also enabled to render the distillation more continuous, and to lessen the danger of empyreumatic products. By the second I increase the percentage of oil in distillate, and by the third save time or fuel. The main object of the whole invention is economy of cost of apparatus, and of time and fuel in running, and, incidentally, the cheapness and simplicity with which a species of vacuum-still can be constructed. While retaining most if not all of the advantages of water distillation by direct fire I am enabled to substitute for expensive copper stills, each with its own fire-place, a series of wooden or other cheap tanks, of such shape as to be easily loaded and unloaded, and to make one comparatively-small distilling apparatus answer for all. As I can run several charges simultaneously with the same water, or use less water for a fixed amount of charge, or keep up a brisk and continuous circulation with a slow or intermittent fire, both time and fuel are saved. Moreover, having plenty of space in the still-bodies, and not being obliged to fill them with water when I am distilling such charges as cedar, spruce, hemlock, &c., I need not cut the branches up fine.

Figure 1 represents a front elevation of an apparatus for extracting essential oils, constructed according to my invention; Fig. 1[a], a plan of same; Fig. 1[b], a side elevation of same, one tank in section; Fig. 2, a front elevation of modification; Fig. 2[a], an enlarged section of oil-extractor B, Fig. 2; Fig. 3, a front elevation of another modification; Fig. 4, a front elevation of another modification; Fig. 5, a section of another modification; Fig. 6, a section of another modification.

According to the first part of this invention, instead of boiling the charge in water, as in the old-fashioned still, or passing steam through it, either with or without water surrounding it, as is practiced with many herbs, I extract the oil from the charge by water, (which may not or may have some chemicals, such as salt, sugar, hydrochloric acid, &c., mixed with it,) by percolation, lixiviation, or hot infusion. I then pass this water containing the oil into another apparatus, or another part of same apparatus, contact with air being prevented, and there extract the oil from it by distillation, by steam, or direct heat. If necessary, I return this heated water to still-body to extract fresh portions of oil, and then redistill. I so proceed until the charge is exhausted, when charge is removed from still-body. The hot water can be used with fresh charges, if desired. Steam does not necessarily pass through charge. This is one distinguishing feature of this part of the invention. In reference to the second part I mention the well-known fact that, when we extract essential oils by placing charge in water and allowing steam from a boiler to bubble up through the water and the charge both, or when I extract oil from certain green vegetables, (*e. g.*, *gaultheria procumbeus*,) or from almost any dry vegetables, by placing in a cucurbit or tank and passing steam from a boiler up through charge, the percentage of oil in distillate is much smaller than when I place the same vegetable in common still with water and boil charge and water together by fire, or steam-jackets or coils. Many experiments have convinced me that this greater percentage in the latter process of distillation is due chiefly to the greater circulation of water in the old-fashioned still. These experiments have also shown that the percentage of oil in the distillate in both the two former processes may be much increased by causing currents of water (above the usual amount) in the still by mechanical means, such as pumps, steam-jets, or by a *monte-jus*.

In all the figures, A represents the still-body or vessel in which the charge is placed. B represents the oil-extractor or device in which the oil is extracted from the water containing it. It is a species of still suitable for liquids, worked by direct heat or steam. C is the pump or *monte-jus*, or other mechanical device, for imparting motion to or lifting the water used to extract the oil.

Similar letters represent corresponding parts.

The single-barbed arrows represent direction of water; double-barbed ones of simple steam; tripple-barbed ones of steam laden with vapor of oil. The sign + indicates a closed stop-cock. The sign — an open one.

Description of Fig. 1: A A and A′ A′ represent two series of wooden tanks, of any convenient size. Only two are represented in each series, but I can have any number, from one to a dozen or more. I will consider them, internally, six feet high, five feet wide at top, and four feet at bottom. They should be made of sound well-seasoned two-inch pine or hemlock plank, and properly hooped. The bottom of series A A is four feet higher than top of series A′ A′. Each tank (they are all similar) is provided with a false bottom, *a*, supported two inches above true bottom, and pierced with many half-inch holes. *a* is covered with a sheet of brass or copper wire-cloth, of sufficient fineness to prevent any portion of charge from passing through. Sometimes it may be desirable to place over this a layer of coarse crash towel-stuff. *b* is the cover to tank. It is removable, and can be rendered tight by packing with oakum. It should be fastened down when using. It has two ring-bolts for convenience in handling. A short one and a half-inch pipe, C, provided with a cock, proceeds from side of tank under false bottom *a* to pipe *d*, leading to oil-extractor B, or to pipe *d′* leading to pump C. The inner end of C is provided with a strainer of large area, so that no leaves, &c., can enter *c*. There is a three-fourths inch tube, *e*, (not shown in Fig. 1, but a similar one is shown in Fig. 2,) for permitting egress or ingress of air to tank when cover is on. One end is connected with tube *m* leading to cooler, and the other is closed, but sends branches *f f*, each provided with a cock, to each tank, entering it just under cover. Under the cover *b* is the spreader or sprinkler D. It consists in this case of a revolving horizontal tube *g*, closed at the ends, and supplied with water at the center. Holes are pierced on opposite sides near the ends, so that the reaction of the water escaping shall cause the tube to revolve in a contrary direction, same as Hiero's steam-engine, or Barker's centrifugal mill. Close under this, and also supported by the cover, is a disk of strong wire-cloth, *h*, to prevent charge from interfering with revolution. Any other device may be adopted which shall spread water over top of charge. *i* is a tube fastened firmly to cover *b* and bent at right angles. One end is attached to the hollow arbor on which *g* revolves, and the other is connected by a gas-tube union with a cock inserted inside of tube *k* coming from pump C, or tube *k′* coming from oil-extractor B. Size of these pipes one and a half inch. *l l l l* are water-gauges. Each still has a waste-plug, not shown. B is the oil-extractor. It consists, in this case, of a boiler with a labyrinthine bottom, preferably of sheet-copper, nine feet long, forty-five inches wide, and fourteen inches high on the vertical sides. The cover is provided with a tube, *m*, leading to cooler, not shown; also, with a man-hole for cleaning, and a siphon-tube for adding water, when desired; neither shown. As this boiler cannot be subjected to much, if any, pressure, when cooler is properly supplied with cold water, it need not be very strong nor heavy. The inside is furnished with transverse partitions, thirteen inches high and six inches apart, extending nearly across, and placed alternately, as in maple-sugar evaporators, so as to give the liquid flowing through it a zigzag direction. (See plan.) It is heated by a fire, and is placed on an arch, not shown in drawing. (It may be heated by a steam-coil or jacket placed underneath; in which case, if desired, the condensed water may be discharged into pipe *k′*.) The boiler receives water by tube *d* and discharges it by pipe *k′*. A continuous stream flows through it. N is a sliding overflow-tube, by which the amount of water remaining in the boiler may be regulated. It is moved by handle *o* passing through steam-tight packing in top of B. A small boiler could have cover attached by water-joint, and glycerine could be used to fill it. There is a water-gauge in B, not shown. C is a brass force-pump suitable for hot tan-liquor, capable of pumping, say, about twenty-five gallons per minute. It is better to have it run by power and continually while distillation is going on. *p* is an overflow-tube, by which I can regulate the amount of water raised without varying speed of pump. C pumps water *via* *d′* from tanks A′ A′, and forces it *via* tube *k* into spreader D in tanks A A. Where the pump is worked by hand and intermittently, the pump and the tubes d' and k, and their branches, may be larger. g is a pipe, with cock, connecting tube k' with pipe d'. It is seldom used.

All pipes should be, preferably, of well-tinned copper, and well protected from loss of heat by radiation by covering with some non-conducting medium. It is also advantageous to incase the tanks with some non-conductor.

The external ends of d, k, and k' may be closed or furnished with cocks and terminate in tanks for the tea. d' may terminate in a well or cistern, to supply pump with water when desired.

To use: Fill tanks with charge, (*e. g.*, teaberry leaves,) packing down as firmly as possible, and putting weights on top. Then close cocks in pipes c c and fill with water; let macerate sufficiently, then draw off water in lower series A′ A′, reserving for future use in upper series, if desired; put on covers, and connect tubes i i with cocks in sides of tubes k and k' by means of unions; start fire and let water run from some tank in upper series—say No. 3—through boiler B into No. 2, with such a rapidity as to be heated to about 90° Fahrenheit, and start pump C, regulating amount pumped by overflow-tube p. The water passes from pump C up tube k and branch i, and sprinkler D in tank No. 3, and is sprinkled over charge, and percolates through charge, and then passes by branch c and pipe d to boiler B, where it is more or less heated, and passes thence, *via* overflow-tube n, and tube k', and branch i, and spreader D, in tank No. 2, and percolating charge passes *via* d' to pump C again. The arrows show the above-described direction of water. In a little while the water and both charges are heated to 212° or thereabout, and the water dissolves more or less oil in its passage through the charges. Now, if I have only these two tanks to exhaust I continue on in the same manner. The water containing oil is boiled in boiler B, and steam laden with vapor of oil passes *via* m to cooler, which is similar to those in ordinary use. After the water in B has been boiled it percolates two tanks, viz., No. 2 and No. 3, before it comes again to boiler to be reboiled. I continue on in this manner till charges are exhausted, regulating the flow by the cock in c in upper tank, so as to obtain the greatest percentage of oil in distillate. This flow will, of course, depend upon the fire and nature of charge. Where I have four or more charges to exhaust at one running I heat up two of them, and then let them infuse while I am heating two more, and then distill alternately. After two stills have been exhausted the heated water can be used with two more stills which have been properly macerated; but perhaps there is a slight loss of oil in using water over. Where I have a large series and plenty of power, and run charges alternately, I may have an extra pump with suitable pipes and cocks, and keep up a circulation in the tanks which I am infusing. These stills, when properly protected from loss of heat, do not cool quickly, but they can be easily unloaded hot by a harpoon-fork. I use one suspended from a small crane, and empty a still charged with cedar boughs in from two to four forks full, and in about five minutes.

I may, of course, dissolve chemicals, such as salt, &c., in the water, but I obtain very satisfactory results using water alone. If I wish to clean the apparatus to use for other oils, put water in tanks and proceed as before.

I can easily convert one of the upper tanks into an effective kind of vacuum-still even without packing it tight. To do this the boiler should be, of course, sufficiently strong to resist the pressure, and should be of an arch shape. Then, if I connect a receiver and an air-pump to extreme end of cooler, and shut off all lower tanks and open cock in tube q, I have a vacuum-still, of course closing tube e, not shown in drawing.

To use: Start the air-pump, and regulate cock in c and pump C so that the pump shall pump out water from boiler as fast as it is sucked in *via* tube c. Proceed as before. There is a vacuum in boiler, and water boils at, say, 150°. This water passes from boiler *via* pump to tank A, and then percolates charge. There is no vacuum in this tank, but water at 150°, or even at 120°, will extract more or less oil from charge which it carries to boiler B, and there give it off, and then goes back for more oil. In using this still as first above described I make use of all three parts of my improvement in the act or process, viz.: I transfer oil to water in A or A′, and extract it from the water in separate vessel, B. I cause currents in A by means of pump C, and I simultaneously extract oil from two charges, viz., those in No. 2 and No. 3, with the same water.

Modifications: I may, of course, vary the mechanical arrangements, the principles remaining the same. I may vary the construction of the tanks A A or the manner in which a series are connected, or the oil-extractor B, or the water-mover C. Again, I can construct modifications in which all three of my improvements in the art or process may not be used, and in which all the combinations I claim may not be used. I will mention some of the modifications of the three principal parts A, B, and C, and then describe some modifications of whole apparatus. The tank A, instead of being arranged for percolation, may be arranged for infusion and expression, as in Fig. 4, where it is a large press. In Fig. 1 I may have three or more series of tanks on as many different levels, or I may have only one series, substituting a tank or reservoir for for either series. Or if the pump is worked continuously I may dispense with either series, pumping directly from or into boiler B. I may run simultaneously a series of tanks on same level as shown in Fig. 2. I may have B as in Fig. 2, where it is a modification of an alcohol distilling column, or as in Fig. 3, where it consists of two parts, viz., a common boiler and a separator; or as in Fig. 4, where it is a tank with steam admitted in rose-jet in bottom. I may substitute a centrifugal pump for C, as in Figs. 5 and 6, or a *monte-jus*, as in Fig. 4.

Description of Fig. 2: In this modification the series of tanks is on the same level, and I extract the oil from the water by steam instead of direct heat. (A^1 A^2, tanks; B, oil-extractor; C, pump, as before.) The tanks are similar to those in Fig. 1, save that they have no spreaders D. The water enters tank from preceding tank or from pump C, *via* tube *k*, by means of a short tube, *i*, inserted in left-hand side near top, and leaves tank by a tube, *c*, near bottom on right hand. *d* is a tube leading to oil-extractor, and *k* tube from pump. A short branch, furnished with a cock, connects tube *k* with each tube *i*. A similar branch with a cock connects tube *d* with each tube *c*. Moreover, a tube-furnished cock connects tube *c* of each tank with tube *i* of next right-hand tank. The tube *c* of extreme right-hand tank is connected with tube *i* of extreme left-hand tank. All tubes are two inches in diameter. Only four tanks are represented in drawing, but I can have more. *e* is a tube sending a branch, *f*, to each tank as near cover as possible, and terminating in pipe *m* leading to cooler. Its object is to allow air to escape from or to fill tanks. Each tank has a water-gauge and a waste-plug. The oil-extractor B is a modification of the alcohol-distilling column and corresponds to what I believe is called the analyser. The water from the still-tanks enters at the top by tube *d* and passes from bottom to pump C, by which it is forced up to repercolate two or more charges before coming to B again. B consists of two parts, the column F and the reservoir or boiler G, shown in enlarged section in Fig. 2^a. F has ten plunging chambers sixteen inches in diameter, each provided with four plunging tubes and a two-inch overflow-tube, reaching about four inches above partition or floor and extending to nearly bottom of next lower chamber. Each floor has a small hole, so that all liquid may escape from the bottom when the column is not in use. The nine lower chambers are each eight or ten inches high, and the upper one about twenty-two inches. The water enters the upper chamber from a rose-jet, *r*, attached to end of tube *d*, and from this chamber the pipe *m* proceeds to cooler. This chamber is larger than the others, and the first portion of *m* is large and vertical, to allow any water mechanically mixed with steam to settle. The column may be in four parts and held together by bolts. The inner plunger-tubes are two inches in diameter and six or eight inches long; the outer tubes three inches in diameter and same length. The reservoir G is two and a half feet square and eighteen inches high. It has a water-gauge and sliding overflow-tube *n*, of which *o* is the handle. *s* is a one and one-fourth inch pipe from a steam-boiler, not shown. It forms a flat coil on floor of G, and is pierced with many small holes to break up steam. G is connected with the lower chamber in E by overflow and plunging tubes. C is a pump as before, but may be a little larger. When in use the steam passes up the column and taking the oil from the descending water carries it to cooler *via m*. A branch of pipe *k* may terminate in water-tank. B should be protected from loss of heat. I can case it in wood and fill intervening-space with sawdust. All tubes and the tanks also should be protected. If reservoir G is larger the pump need not be worked continuously.

To use: Suppose all four tanks to be properly macerated, and A^2 and A^3 to be full, and A^4 to be half full of water of maceration, A^1 to contain no water. Arrange cocks, as shown in drawing, where the sign + indicates a closed cock and the sign — an open one. The water from A^4 passes along tube *d* to column and filling each chamber four inches high overflows to next lower chamber. When water reaches G and overflows sliding overflow-tube *n* I start the pump C, regulating the amount raised by means of the overflow-tube *p* so as to maintain water at the desired height in G. Then let on steam. The water will be gradually warmed, and will be forced up and discharged into upper left-hand side of tank A^2, and as this tank is already full it will overflow from bottom of A^2 by pipe *c* into pipe *i* near top of A^3. A^3 in a similar manner overflows into A^4, from which the water will pass again to B. In the course of time all this water will be heated to boiling point, and then steam richly laden with vapor of oil will pass along pipe *m* to cooler. In the course of time A^2 will be exhausted. Now, to throw this tank out and add a fresh one to those undergoing distillation I open cock, allowing water to pass from *k* to A^3, and shut it off from A^2. I then close cock opening from A^4 to K and open that in tube connecting *c* in A^4 with *i* of A^1. The tank A^2 remains full of water, but I allow this to flow direct into *d*, and turning down or off steam, pump the water rapidly into A^3 *via* B. I may let on a little steam during this pumping, to prove if A^2 is fairly exhausted. When A^2 is empty let A^1 flow into *d* and proceed as before. In this arrangement I exhaust three charges at once, but am obliged to have nearly three tanks of hot water to do it. However, after I have once heated the water I can use it to exhaust a dozen tanks. When distilling, regulate the flow of steam and water in B so as to obtain the richest distillate. If water is supplied fast and any oil remains in it after passing through B it is not lost, but is brought back to B again. If steam is in excess there is merely a waste of fuel. Where the tank and pipes are not well protected from loss of heat pipe *d* may be longer and form a coil in a steam-chamber, where all water passing through it, when distillation is going on, can be heated to 212° or thereabout before being discharged from rose-jet *r*. The steam coming from pipe *m* will answer for this purpose, and the steam-chamber can be placed on column F. The reservoir G may be a boiler itself, the column being placed over it, thus dispensing with a separate boiler. I may arrange a series of still bodies, A A, on same level with a pump, C, and spreader D to each still, so arranged that the pumps will keep a more vigorous circulation; but it is too expensive.

Description of Fig. 3: In this there is a modification of the oil-separator B, and it is so constructed that I can dispense with the pump after the water has become heated. A is one of a series of tanks similar to A A, Fig. 1; *d*, a two inch pipe, corresponds to *d*, *m* to *m*, and *k* to *k*, Fig. 1; *e* to *e*, Fig. 2. C is a force-pump with valves reversed—*i. e.*, so constructed that it will force water downward, and so that a continuous stream of water may flow down C when it is not worked, and the valve will act as a check-valve to prevent its return. The oil-extractor consists of two parts, H and I. H is a vertical tubular boiler, exposing about ten square feet of surface to fire, and of comparatively small capacity, say seventy-five gallons. It need have no gauge-cock, and need not be very heavy. It should have a man-hole for cleaning. It is placed lower than the bottom of A, and should not hold over half the quantity of water usually used in distilling a charge. It may be so small as to hold only a sixth. I is the separator, where the steam and water separate. It may be of copper or wood, about the size of a large barrel, and well protected from loss of heat. *t* is a three-inch tube connecting H with I. The upper end rises into the middle of I, and is provided with a valve-cap, which rises when water or steam is discharged, and deflects the water against sides and bottom of I, and closes when there is a vacuum in H.

To use: The charge in A being properly macerated, start a brisk fire under H and force down water into it. This water will be more or less heated, and, rising into I, will back to A. When water reaches boiling point we can stop the pump, for the steam generated in H will rise into I, carrying with it much water, from whence steam will pass to cooler and water to A. The pump can be arranged so as to pump the water up from H while heating, instead of forcing it down, gravity refilling it. (I presume the above-described combination of H and A is covered by my patent of January 17, 1871. If so, I do not here claim it, but introduce the figure to illustrate various parts of my invention.)

Description of Fig. 4: In this I transfer the oil to the water by infusion and expression, and raise the water by a *monte-jus*. A represents a section of one of a series of still-bodies, each constructed so as to be used as a sort of press. It is six feet high and three and a half feet wide, sides vertical, strong, and thick, and the whole well hooped. There is a lining of sound one-inch boards, pierced with many holes, and channeled down the back. U is a press-block, forced down by a screw working in a female screw in a beam overhead. *d* is a pipe to oil-extractor B; *e*, air-pipe, not shown. B may be a strong copper or wooden cylinder of capacity equal to A, with a rose-jet at bottom, connected by pipe *s* with steam-boiler. The pipe *m* to cooler is provided with a cock or gate. B has water-guage, as has each tank.

To use: Let charge macerate, then let water down into B and heat by steam from rose-jet. When heated close cock in *m*, and water is forced back into A *via d*, the air escaping by pipe *k*. (I can have an additional pipe, *k*, if desired.) Then heat water for next tank, the first one infusing in the mean time. Then, having forced water back to second tank, let down that from first and distill. Then force back to infuse longer, and in the mean time distill water in the second. Of course I can have B a boiler instead of a tank with steam-jet.

Description of Fig. 5: This is a combination of a pump with an ordinary steam-still to illustrate second or sixth part of invention. A is one of a series of still-bodies similar to A, Fig. 1, save that it is seven and a half feet high, and false bottom *a* is about twenty inches above true bottom. The cover *b* is in two parts, in the smaller of which is the pipe *m* to cooler; this part being permanent. The larger is removable and has spreader D, consisting in this case of a vertical jet impinging upon a horizontal plate, with a small cone in center. The steam-pipe *s* terminates in a rose-jet close under false bottom A. C is a small centrifugal pump fed by *d*, and throwing water along *k*.

To use: Have water about one foot high in bottom, start pump, and let on steam. The distillate is much richer when pump is used than when it is not, and I can use herbs so dry that steam alone is not suitable. After a thorough drenching with warm water steam extracts the oil more readily, even when pump is not running; therefore I can use one pump with a large series, running pump on each intermittently. With some herbs it may be desirable to fill the still nearly full of water. With this arrangement—*i. e*, still full of water—there is a decided increase of oil in distillate when pump runs. Of course other water-raisers may be used.

Description of Fig. 6: This consists of a combination of a centrifugal pump, C, with an ordinary still, the object being to save time or fuel. A slower fire can be used or a richer distillate obtained.

In the foregoing specification I have described the three below-mentioned improvements connected with the art of extracting essence of oil, which I do not here claim; but I do not abandon them. I reserve to myself the right to make subsequent application for patent. First, the mode of unloading hot stills by harpoon-forks; second, the vacuum-still; third the improvement in the art or process by simultaneously or intermittently passing steam and water through charge.

I am not aware whether essential oils have or have not been extracted by percolating with alcohol and distilling this alcohol. I limit my first claim, the using water, which may or may not contain chemicals, and distilling this water in separate vessels or apparatus, or separate part of same vessels or apparatus. In a patent for improvements in apparatus for extracting essence of oils, issued to me January 17, 1871, No. 110,998, I described stills where currents of water were caused or produced by jets or currents of steam. I did not there claim any improvement in the art or process, but merely a combination of a device called a "heater," with a still. In this heater the currents were produced by jets or currents of steam, not by pumps. I do not wish in this present application to claim anything covered by the claim in said patent; but, should the claim be in any way conflicting, the claim in said patent is in all cases to take precedence, and the claims in this application to be considered in the light of subsequent improvements. I do not here claim, in itself, any form of tank A; nor, in itself, any form of oil-extractor B; nor any form of pump C.

I claim the three following improvements in the art or process of extracting essential oils, each substantially as and for the purpose hereinbefore described—

1. Extracting the oil from charge in the still-body by water, and the subsequent separation of the oil from this water by distillation in separate vessels or apparatus, or separate parts of same vessel or apparatus.

2. The producing or increasing currents of water in still-bodies by pumps.

3. Exhausting two or more charges in separate vessels at once by the same water, and using but one distilling apparatus.

4. The combination of a single still-body, A, or a series of still-bodies, A A, with a pump, C, or its equivalent.

5. The combination of a single still-body, A, or of a series of still-bodies, A A, with an oil-extractor, B, or its equivalent.

6. The combination of a single still-body, A, or of a series of still-bodies, A A, with a pump, C, or its equivalent, and an oil-extractor, B, or its equivalent.

7. The combination of a series of still-bodies, A A.

8. The combination of a still-body, A, and a spreader, D, or its equivalent.

9. The combination of a still-body, A, with a boiler with a labyrinthine bottom, all substantially as and for the purpose specified.

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