Specification of Neil Arnott : furnaces; steam and air engines; distilling, evaporating, and brewing apparatus.

A.D. 1821 . . . . . N° 4615.

SPECIFICATION

OF

NEIL ARNOTT.

FURNACES; STEAM AND AIR ENGINES; DISTILLING, EVAPORATING, AND BREWING APPARATUS.

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ARNOTT'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, NEIL ARNOTT, of Bedford Square, in the County of Middlesex, Doctor of Medicine, send greeting.

WHEREAS His most Excellent Majesty King George the Fourth did, by His Letters Patent under the Great Seal of that part of the United Kingdom of Great Britain and Ireland called England, bearing date at Westminster, the Fourteenth day of November, in the second year of His reign, give and grant unto me, the said Neil Arnott, my exors, admors, and assigns, His especial licence, full power, sole privilege and authority, that I, the said Neil Arnott, my exors, admors, and assigns, during the term of years therein mentioned, should and lawfully might make, use, exercise, and vend, within England, Wales, and the Town of Berwick upon Tweed, and also in all His Colonies and Plantations abroad, my Invention of "IMPROVEMENTS CONNECTED WITH THE PRODUCTION AND AGENCY OF HEAT IN FURNACES, STEAM AND AIR ENGINES, DISTILLING, EVAPORATING, AND BREWING APPARATUS;" in which said Letters Patent there is contained a proviso that if I, the said Neil Arnott, shall not particularly describe and ascertain the nature of my said Invention, and in what manner the same is to be performed, by an instrument in writing under my hand and seal, and cause the same to be inrolled in His Majesty's High Court of Chancery within six calendar months next and immediately after the date of

the said Letters Patent, that then the said Letters Patent, and all liberties and advantages whatsoever thereby granted, shall utterly cease, determine, and become void, as in and by the same, relation being thereunto had, will more fully and at large appear.

NOW KNOW YE, that in compliance with the said proviso, I, the said Neil Arnott, do hereby declare that the nature of my aforesaid Invention, and the manner in which the same is to be practised and carried into effect, is fully described and ascertained in the following description, and the explanatory Drawings or Figures thereunto annexed, that is to say:—

My improvements consist, first, in particular means of burning or destroying smoke, and thereby converting it into so much additional fuel; secondly, in particular means of making fuel burn in condensed air, either to produce intense heat for various purposes or merely to heat the air itself, so that its increased elasticity may become a motive power applicable to the purposes of labour in moving machinery; thirdly, in making liquids boil, evaporate, or distill rapidly at heats much below their boiling points, by particular means of removing or lessening the atmospheric pressure upon their surfaces; and, fourthly, in particular means of cooling hot liquids in the process of brewing; all which said purposes I produce and bring about as follows: And, first, I burn or destroy smoke by introducing the fuel into my fire-place through a number of metallic channels or troughs, against the inner mouths or openings of which the burning fuel lies, and between which, as between the bars of a grate, there are interstices for the passage of fresh air. The smoke given out from the advancing fresh fuel is thus made to pass through the ignited fuel, and while it is thus intensely heated it is at the same time intimately mingled with the fresh air entering between the troughs, and is totally or almost totally consumed. Fig. 1, in the annexed Drawing, exhibits a perspective view of a fire-place, with a convenient form and disposition of these troughs, in which six of them are shewn with their oblique mouths projecting into the fire-place. They may be formed of wrought or cast iron, and are disposed side by side in nearly parallel directions, as shewn at the letters *a*, *a*, *a*, *a*. They should not be much more in width than the ordinary fire bars used in furnaces, viz^{t}, about two or two and a half inches, but should increase a little in width as they approach the fire, to facilitate the passage of the coals through them, and they are maintained in their parallel position by bars of iron rivitted to them both above and below, the ends of which are seen at *b*, *b*, *b*, *b*. By the same means each chamber is retained and held at about half an inch distance from that which is next or contiguous to it, and thus the interstices or channels before-mentioned are formed as at *c*, *c*, *c*, for the passage of air to the burning fuel;

but the upper parts of these are channels between *b* and *b*, are stopped or closed up by the introduction of square iron bars between one chamber or trough and another, as may be seen at *d*, *d*, *d*, and more distinctly at *d*, *d*, *d*, Fig. 2, which is a plan of the same apparatus, or at the same letters in Fig. 3, which shews the elevation or appearance the apparatus assumes when viewed from the end at which the coals or other fuel (which I always use broken into small fragments) are introduced. The stopping of these channels may also be effected by uniting the upper edges of the chambers or troughs together, if they are formed of sheet iron or cast with flanches, and the number of troughs or chambers of which I make my apparatus consist, as well as their length, must in all cases depend upon the extent and intensity of fire that may be required. From the above description it will appear that any broken or pulverized coal or other fuel that is placed upon the top of the apparatus, as at *d*, *d*, *d*, will fall down and distributed itself into the several chambers or troughs before described, from whence it is to be pushed or protruded as occasion may require from the open ends of these chambers or troughs, which are cut down in an angular form, as may be distinctly seen at the letters *a*, *c*, *a*, *c*, Fig. 1, into the body of the fire, burning over the common or ordinary grate bars, as at *e*, *e*, in Figs. 1 and 2. This protrusion of the coal or other fuel I effect either by a single or fork-like stoking iron, to be applied at the end of the troughs next to *f*, made to fit into them. The whole of the above-described apparatus may be moveable so as to be detached from the fire-place to be charged or filled with fuel, or it may be a fixture and be filled or charged in its proper situation, in either of which cases the apparatus rests upon the bearing bars *g*, *g*, and *h*, or upon a cast iron or other plate capable of supporting it, but which must not extend beyond the bearing bar *h*, because it is necessary that the channels or spaces between the angular ends *a*, *c*, *a*, *c*, of the several chambers or troughs should have free access of air underneath them, in order to supply the fire burning upon their upper edges, and to permit the fall of the ashes into the ash pit *i*. The extreme points or ends of these troughs rest upon the bearing bar *h*, which also supports one end of the ordinary grate or fire bars *e*, upon which a fire is to be kindled in the first instance, which will soon communicate with the fuel lying upon the sloaping edges of the troughs at *a*, *c*, *a*, *c*, and this will burn by having a free current of air between the troughs as above described, and this fresh air mingling with the smoak generated by such combustion will pass together over the fire burning upon the bars *e* to the flue or chimney *k*, and cause the whole smoak to be enflamed or consumed and converted into additional fuel for heating any vessel or thing placed over it; and since by pushing in the fuel from the end *f* of the troughs it will rise in an equal and parallel

stratum to the inclined surfaces, and will even become churred or partially burnt before it so rises, so it is evident from the immediate mixture of atmospheric air and smoak that this arrangement of apparatus insures that the greatest part, if not the whole, of the smoak produced from its fire must be consumed. This arrangement of apparatus for consuming smoke being applicable to fire-places already built on other constructions, they may be altered accordingly; and I therefore claim the appropriations of this part of my Invention whenever it may be so used and applied. Secondly, when I require my fire to burn in a condensed atmosphere for producing intense heat, either for heating and expanding air to produce motion, force, or for any other purpose, I use and employ the following arrangement of apparatus:—In the first place, the fire-place is constructed as already described at Figs. 1, 2, and 3, or in any other convenient form, but instead of being open, as in that case, the fire burns within a large but close vessel of cast or wrought iron, as shewn at A, A, A, A, in Fig. 4, which I call the air chamber, and in which B is the fire-place aforesaid; the set of chambers or troughs for containing the fuel slide in, as before described; or may be fixtures, but if they slide they do so into a rectangular projection from the air chamber, as shewn at C, which also points out a door or shutter which is to be closed in an air-tight manner by screws, wedges, or any of the usual contrivances after the fire has been lighted and the fuel introduced. The ash pit D is likewise so air-tight that any air admitted into it can only escape by passing upwards through the fire. In order to introduce air to the fire, I use a blowing cylinder, either of the ordinary and common construction, or like that shewn at E in the form of an inverted syphon. This cylinder is worked in the manner herein-after described. In Fig. 4 E is the bored cylinder or working barrel; F, the piston, the rod of which works through a stuffing box on the top of the working barrel; G a valve opening inwards to admit the air; and H another valve opening outwards for its escape. The cylinder I has immediate communication with that at E, and is equipped with similar valves in its top, K being for the admission of air, and L for its escape into the tube M, which is common to both the valves H and L. The lower parts of the two cylinders E and I, may be fitted with water or oil, as coloured green in the Drawing, which will obviate the necessity of fine workmanship or fitting; but if the apparatus is well made, it will act without this, and may be made of smaller capacity. All the air blown into the tube M is to be delivered into the ash pit D, and the regulating cylinder or gasometer N (for either form can be adopted at pleasure), by which it will be returned or delivered out again in a steady and equable blast by the continuation of the

pipe O, placed in any convenient situation for the purpose, into the box or ash pit D; from this it must pass through the fire above it, and by being heated it will be very considerably increased in volume as it rises into the upper part of the air chamber A, A, A, A, and may then be employed to work its own blowing cylinder, as herein-after described, without the assistance of any other power; and the fire so produced and maintained may be applied to all the purposes for which strong close fires are required, by suiting the form, construction, and materials of the air chamber and fire-place to the circumstances the particular case may require. A pipe which contains a throttle or register valve, to be opened in a greater or less degree, or quite closed where the apparatus is at work, is placed at the top of the air chamber, as at P, for the escape of the heated air and smoak during the lighting of the fire. In order to convert the heated and condensed air thus produced to the beneficial purpose of giving motion to machinery, and of thus becoming a motive power, as herein-before mentioned, I adopt some or one of the following arrangements of machinery:— Instead of permitting such heated and expanded air to escape by the chimney P, I close its valve or regulator entirely, and by the pipe Q such air is conveyed to a cock or valve, or cocks or valves, placed in some convenient part of that pipe, as at R, and which, by being constructed on principles similar to the cocks or valves placed in the steam pipes of steam engines, will have the effect of conveying such heated air alternately to the two opposite sides of a moving piston, or into a mercantile gasometer or gasometers placed to receive it, and properly attached to the machinery to which it is desired to communicate reciprocating motion; such a cock or valve as I have invented for and which perfectly answers this purpose will be herein-after described; but at present let it be admitted that its construction is such that it will first permit the heated and expanded air to pass through the pipe S for a certain time, and then will shut up that pipe and permit it to pass through the pipe T, and so alternately. It will then first act upon the surface of the water V placed above the piston U, and will force that piston to the bottom of the bored cylinder W, W, and will expel the water X placed under that piston, and cause it to rise in the cylindrical or other shaped vessel Y, while the air previously contained in that vessel will escape by the pipe T, and will pass off through an opening provided in the cock or valve at R; this done, the pipe S becomes closed and T opened to the heated air, which will now act on the surface of the water Y and depress it, by which the piston U is again elevated and ready for another depression (the air above it escaping as aforesaid); and as the piston U is connected by a piston rod Z, with the machinery it has to move either by a parallel motion apparatus and beam, such as are used for steam engines or by any of the known

and accustomed means, and which, therefore, are not here described, as not constituting parts of my Invention; so likewise it will be seen that the blowing piston F may be moved, as well as the cock or valve or valves for regulating the distribution of the heated air as aforesaid, without external aid or power. It will likewise be apparent that if such heated air be admitted and received alternately beneath the moving parts of two material gasometers properly disposed or alternately above and below the moving part of a single gasometer inclosed in a case, and having a rod working through a stuffing box on such case, that such moving parts of the gasometers will alternately rise and fall with a force and velocity dependant upon their horizontal area and magnitude, and consequently that alternating motion may be given to machinery in this way in addition to the manner already described. Also, in the event of only requiring a single powerful action, or one which acts with power on one side only of the piston U, as in the case of using the power for working a lifting pump or blowing its own fire as aforesaid, it may be produced by a very simple alteration of the machine, which I have so far described in one form only, although it will be evident to any mechanic that the principle admits of many forms and modifications which are too obvious to need particular description. Thus, for example, if the heated and expanded air produced as aforesaid in the air chamber be in the first instance admitted by the pipe T into the vessel Y, it will depress the water therein and elevate the piston U; and if the space V is fitted with air instead of water, then that air or any part of it, according to the time at which the admitting valve is shut, may be conveyed immediately by a pipe containing a valve opening outwards into the regulating cylinder or gasometer N for the supply of the fire. In this way the separate blowing cylinder E, with its several appurtenances, may be altogether dispensed with; but in this case there must be a valve opening inwards upon some part of the top V to admit a fresh supply of air as the piston descends; and this descent may be produced by a fly wheel, or by loading the piston rod Z with sufficient weight, as in the case of single steam engines. The section of the working cylinder W, W, as represented in the Drawing, shows that it is detached and separate from the water or external case V, X, Y; it is however merely arranged in this way for the facility of boring that cylinder; and it is scarcely necessary to say that it may be so made and fixed in its place by caulking in oakum, or applying cement or other fit material in the space *a*, *a*, or it may be formed with nouzles and flanches at the discretion of the manufacturer, or the water may be contained in separate vessels, one opening into the space V above the piston U, and the other into the space X, beneath it, or the working cylinder may be fixed in an horizontal position with the two water vessels at its opposite ends. It will,

however, be necessary to place floating boards above the surfaces of the water that come into contact with the heated air, as at *b*, *b*, and since that water will become heated and will evaporate and diminish in quantity, by which the proper action of the machine would be impeded, so as to prevent this, I apply the contrivance shewn at *c*, *c*, near the bottom of the cylinder W, W, and immediately above its top; *c*, *c*, is a pipe communicating with a reservoir raised to a sufficient height to enable the water to flow into the cylinders Y, V; at the lower end of each pipe *c*, *c*, is a small valve opening towards the said cylinders as shewn at *d*, *d*, so as to permit water to enter them; *e*, is a throttle or swivel valve which closes the pipe entirely when shut, and consequently prevents any water passing into the cylinders; and *f*, *f*, are small tails or levers passing from the said valves into the interior of the cylinder, and by which they are to be opened.

Whenever, therefore, the quantity of water in V or Y becomes too small the floats *b*, *b*, will descend lower than they should do, and by striking against the tails *f* will open such valves, and admit the necessary quantity of water. An air adjustment will likewise be necessary to equalize the quantity of air in V and Y, and to prevent the possibility of a vacuum or rarefraction ever taking place in these spaces; and this I provide for by placing a small valve, as at *g*, *g*, in each of the hot air pipes. These valves must open inwards towards such pipes, and are kept shut by very weak springs, so that they will act spontaneously whenever their action may become necessary. Figs. 5, 6, 7, and 8 are different views of the cock or valve before-mentioned, by which the alternate distribution and final discharge of the heated air when done with is effected. Fig. 5 is a general section of such in its entire state. Fig. 6, the fixed or external case, with its lid as well as the brass regulators removed to show the several passages; and Fig. 7 the same view, still without the lid, to shew the brass regulator in its proper situation. In Figs. 5 and 6, *a* shews a part of the pipe Q (Fig. 4) by which the heated air is brought from the air chamber into the cavity *b* of the cock; C is an opening into the pipe *d* (being part of the pipe S, by which such hot air is carried to the space V, Fig. 4) *f*, a similar opening into the pipe *e* (being part of the pipe T, Fig. 4); and *g* is a circular entral opening by which the heated air is finally discharged into the pipe or chimney *h*, Figs. 4 and 5, when done with. In Fig. 6 the hot air entering at *a* would have an equal facility of passing out of any of the openings *c*, *g*, or *f* in common; but on introducing the brass regulator *i*, *k*, which is truly ground to the fixed case, Fig. 6, so as to be air-tight, into its proper place, as shewn in Fig. 7, all the openings except *c* become closed, and this is alone left for the passage of such air to one side of the working piston; but

although the openings *f* and *g* are closed, as respects the opening *a* (which is always open), yet they are not closed with respect to each other, but have an immediate communication on account of the form of the brass regulator, which rises at *i*, so as to form a cavity in Fig. 5 (more distinctly shewn at *m*, Fig. 8, which shews the under side of the brass regulator, or the opposite one to that shewn in Fig. 7. By inspection of Fig. 5 it will, therefore, appear that hot air entering at *a* will pass through *c* and along *d*, while the air from the opposite side of the piston can enter *e*, pass through *f* into the cavity *m*, from whence it will escape through *g* and *h*; but on turning the brass regulator, Fig. 7, until its opening *c* comes against the part marked *l*, then the hot air coming in at *a* cannot pass into either of the pipes *d* or *e*, but is completely stopped and prevented from acting, while the pipe *e* is still open to the chimney *h*; continuing the motion of the brass regulator, Fig. 7, untill its opening *c* comes opposite to *e*, then a contrary action takes place, for now the heated air from *a* will pass along the pipe *e*, while the pipe *d* will be opened through the cavity *m* to the chimney *h*, and consequently such heated air will act on the contrary side of the piston; and by turning the regulator till its opening *c* comes against *a*, then the pipe *d* will still be shut as respects *a*, but open to the chimney and *e*; and thus by a simple rotatory motion of this regulator will all the alternations of action above described be produced. This rotatory motion I produce and bring about by a rod or bar properly suspended in the position shewn at *n*, *o*, Fig. 4, one end of it resting upon the wheel or rigger *p* upon the fly-wheel shaft, while the other rests upon a similar but smaller wheel fixed upon the spindle *q* of the brass regulator, Figs. 5, 7, and 8. This spindle passes through a stuffing-box in the lid of the cock, and to insure the correct revolution of the brass regulator, a tube with a conical termination rises from its central part, as at *r*, *s*, *t*, Figs. 5 and 8, which fits into a similar concave conical recess *v*, *v*, in the bottom or bed of the cock, Fig. 6, to serve also as an opening into the chimney *h*; and an oblong orifice *t*, Fig. 8, is made through this tube, as may also be seen at *t*, Fig. 5, to establish and maintain a constant communication between the cavity *m* in the brass regulator and its central cavity *v*, which always coincides with and is open to the chimney tube *h*. I prefer placing this cock in a vertical position, or with the hot air passage *a* at the top, because then a quantity of oil or grease may lay in the lower part of the interior of the cock, as at the dotted line *u*, *u*, Fig. 7, so that the brass regulator may move in it, by which friction will be prevented, while the ground surfaces will be kept air-tight; and this effect is further promoted by the pressure of the conical wire spring *y*, seen in Fig. 5. The motion of this cock is produced by four teeth or projections from the surface of a small wheel or rigger *u*, *u*, fixed upon the regulator spindle *q*, and four

similar projections are formed upon the wheel *p* upon the fly-wheel shaft, Fig. 4; and as two corresponding cocks or projections (which are moveable) are attached by adjusting screws to the swivel bar *u*, *o*, as at *w*, *x*, while that bar is drawn back towards *o*, by a spring fixed to it, it follows that in each revolution of the fly wheel the said brass regulator of the cock will make one revolution by four successive movements of one quarter of a circle each time, and thus the brass regulator of the cock will be put into all the situations herein-before described for producing the alternate distribution and stoppage of the heated air; and these will be found most beneficial for working or moving the engine after the fire has become sufficiently intense to heat the air with rapidity, for I prefer shutting off the heated air at about the half stroke of the piston, and permitting it to perform the rest of its action by expansion; and it will be found that by placing the opening *e* of the brass regulator successively against the points *d*, *l*, *e*, and *a*, Fig. 7, as herein-after described, and continuing the motion thereof regularly round in the same direction, which will be done by the means herein-before described, that all these effects will be produced. Should the machine not be equipped with a fly wheel, then the brass regulator of the cock may be turned, as aforesaid, by a double plug-tree or beam with tappets or projections fixed upon or attached to and moving with the piston rod Z, Fig. 4, or attached to some convenient and proper part of the working beam of the engine, and acting alternately upon one and the other side of the small wheel *u*, *u*. It is intended that the air shall be heated to between 5 and 6 hundred degrees of Fahrenheit's thermometer by passing through the fire, as aforesaid, for working this machine, and by this means it will be expanded to above double the volume which it generally occupies; consequently the blowing cylinder E, I, Fig. 4, or any other construction of blowing machinery which may be adopted, need not send or impell more air at each stroke into the ash-pit D of the fire-place than is equal to half the contents of the cavities V and Y of the working cylinder that is employed; but particular attention must be paid to keeping the passage between those cavities (whatever may be their construction) as wide and capacious as possible for the passage of the water within them as aforesaid; and I regulate and adjust the speed or velocity of these engines by a throttle or other efficient valve placed near the extremity of the pipe O, and worked or operated upon by an ordinary governor, such as is applied to steam engines, or else I cause such governor to act on levers and screws, which prevent the valves G and K of the blowing cylinder from shutting so soon as they otherwise would do, in either of which cases less fresh air will pass into the fire. The surplus air, if any, will escape into the air chamber by a valve *x* in the piston or gasometer, opened by contact with the pin *s*, consequently the machine must diminish in its moving

velocity. Th above description will enable any competent workman to construct the machine herein-before described; but it may be necessary to observe that to use it with effect a glass or other transparent eye piece must be introduced into some convenient part of the air chamber for the purpose of inspecting the state of the fire, and that such fire must be stirred or stoked when necessary by a stoking iron acting through a ball and socket joint, or in some air-tight manner in a convenient part of the said furnace, and that the ashes may be removed from the ash-pit whenever the machine is not at work, either by removing the fuel troughs or channells, or by an air-tight door provided for the purpose in some part of the ash-pit, as at *a*, *a*, Figure 4. Thirdly, my means of producing a more or less perfect vacuum of air upon the surfaces of boiling liquids, to make them evaporate at low temperature, is as follows:—The boiler A, Fig. 9, is supposed to contain the liquor, it must be connected by a pipe B (having a stop-cock or valve in it as at K, and a capacious head or reservoir as *z*, when used for such liquids as froth or boil over) to a metallic condenser of sufficient capacity, and which may be made of a spherical, cylindrical, or any other convenient form, and like the rest of the apparatus of sufficient strength to resist a pressure of more than fifteen pounds upon every square inch. This condenser must be placed upwards of thirty-two feet from the ground or from the bottom of a well or excavation, in order to admit of the metal pipe D (which must be more than thirty-two feet long) being fixed to the lower side of it. E is a cistern or reservoir to receive the lower end of the pipe D, which can be closed by a stop-cock L. Another cistern or reservoir F must likewise be placed at a distance of about sixteen feet below the under side of the condenser C, having a pipe G, which also opens into the said condenser at its upper end, while its lower one dips into water contained in the last-mentioned reservoir F; a valve that opens upwards is also placed in the upper part of the condenser, as at M, and a similar valve in some part of the pipe G, as at H. I is a forcing pump, for drawing water out of the reservoir F, and delivering it into the pipe G, at any place above the valve H. To use the apparatus, the boiler A must be filled with the fluid to be heated, after which the cock K in the pipe above it is to be closed, as well as the cock at L, the condenser C is then to be filled with water from the reservoir F, which being done, the cock L is to be opened, when the water will immediately run out of the condenser, and sink to the height marked thirty-two feet in the pipe D (little more or less according to the state of the barometer), and will leave the condenser in a state approaching to that of a vacuum. Heat may now be applied underneath the boiler A, and upon opening the cock K, a communication will be formed between the vacuous space or interior of the condenser and the interior of the boiler, and the air

remaining in the top of the boiler, together with any steam that may exist in it, will pass over into the condenser, and such air and steam being removed by a second filling of the condenser with water as aforesaid, and then permitting it to run off, the condenser will be left in a state of vacuum, and the two tubes G and D, being connected through the medium of the condenser, will become a general cyphon, for the cold water will rise into the condenser by the tube G, and run from it by that at D, with a velocity that may be regulated by the cock L, and thus will all the steam that enters C be condensed and run off with that water, while a vacuum may be maintained as long as the supply of water continues; and this supply to the reservoir F may arise from a natural stream, or may be produced by pumping water into it, or the condensing water may be pumped constantly to the condenser from the bottom of the reservoir or well, which again receives it on its surface by the pipe D, after it has been used and heated; the same water thus serving continually, and being cooled if necessary by the means herein-after described in speaking of my refrigeratory; and according to the degree of vacuum produced the fluid will boil with a lower or higher temperature, which in all cases will be below the point at which the same fluid would boil in the open air. After a certain lapse of time, should air by any means enter the condenser, the vacuum must be reproduced as before, and by occasional repetitions of these operations a vacuum may be maintained on the surface of the fluid in the boiler for any required period of time. N is a cock for discharging the contents of the boiler when they have been sufficiently exposed to the action of the fire, and *o* a safety valve to prevent accidents. The valve M on the condenser, which opens outwards, is to permit the escape of air when the condenser is first filled with water, and has a safeguard in case of any sudden or unexpected evolution of steam. In all cases where the convenience of situation will admit of, I prefer placing the boiler and the condenser on the same level, and as near together as possible, because then there will be a less length of the pipe B to exhaust; but this arragement can only be effected when the apparatus is constructed on the side of a hill, or over a well or pit that admits of drainage, so as to permit the pipe D to be of the requisite length and yet to part with its water. In the process of distilling, the condensing water must not enter into the condenser, as herein-before described, but must surround the exterior of it, in the manner described in speaking of my refrigitory, to be herein-after described. Fourthly, my refrigeratory for the purpose of cooling the hot liquor with speed and expedition in the process of brewing:—I cause it to pass by means of a pipe (containing a stop-cock to close it), as shewn at Q, Figure 10, into my improved refrigeratory R. This refrigeratory consists of a series of very shallow oblong boxes, formed of copper, tinned copper, or other thin metallic

plates, or other suitable material, the thinner the better, provided it has sufficient strength, and to prevent the sides of such boxes from collapsing by external, or bulging by internal pressure, I cause them to be studded or provided with knobs or protuberances both internally and externally, or by giving them any other sufficient support for such purpose; and these boxes I place side by side, and very near together, as shewn in plan at Fig. 11. The whole of these flat boxes, which ought not to be wider that from half an inch to three quarters of an inch, while their length should be full six times their breadth, are enclosed in a water-tight vessel *r*, *r*, at about half an inch asunder; although but three such boxes are shewn in the Drawing at *s*, *s*, *s*, and in the plan of their arrangement at Fig. 11, in both which cases the lid of the case is removed for the purpose of shewing the arrangement of the boxes.

To give effect to this refrigerator it is also necessary that it should be fixed with the greatest length of its boxes in a vertical direction. The pipe Q, communicating with the boiler or vessel from which the hot liquid comes, passes in a water-tight manner through this vessel, and opens into the top or upper end of each of the flat boxes, while another pipe S passes in like manner and communicates with the other end or lowest parts of all the said flat boxes, so that whenever the cock in the pipe Q is opened, the liquor in the boiler P will run into and through the whole of such flat boxes, and will be discharged at F. An open reservoir of water T is placed and fixed at a convenient distance above the refrigerator R, and the pipe V, which should be rather more capacious than that which conveys the hot liquor, proceeds from the lower part of such reservoir to the lower part of the water-tight case *r*, *r*, of the refrigerator, and enters it near to the discharging pipe F; a similar sized pipe U is likewise fixed to the upper part of the case *r*, *r*, and proceeds from very near the place where the pipe Q enters it, through the bottom of the reservoir T, and continues to near the top of it. The external case *r*, *r*, of the refrigerator will, therefore, always be filled with water by the pipe V, and that water will be in immediate contact with the outer surface of every part of the flat interior boxes aforesaid, and, consequently, while any hot fluid is passing through the insides of them it will communicate its heat to such water in the case *r*, *r*, and that water, by being heated, will become specifically lighter than the water at the bottom of the reservoir T, and will, consequently, rise up the pipe U to the top of the reservoir, to be again cooled by exposure to the atmospere, and thus will be a perpetual current of cold water be maintained down the pipe V, and of heated water up the pipe U, as long as any hot fluid is running from Q to F; but whenever convenience of situation requires the reservoir of water to be below instead of above the refrigerator, then the water must be pumped up, and so made to pass through the case *r*, *r*. The discharging pipe F must be

A.D. 1821. Nov 14. N° 4615.
ARNOTT'S SPECIFICATION.

1 SHEET

FIG. 1.

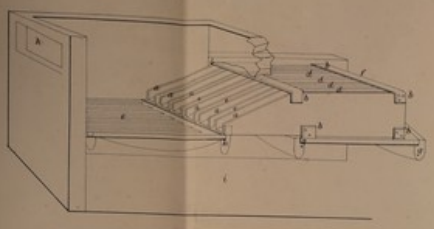


FIG. 2.

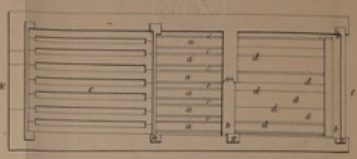
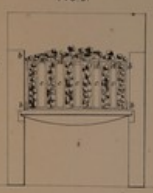


FIG. 3.



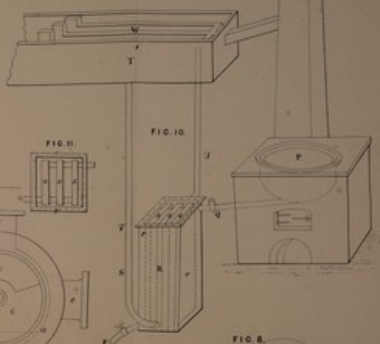


FIG. 10.

FIG. 11.

FIG. 5.

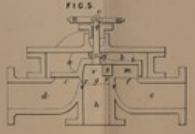


FIG. 6.

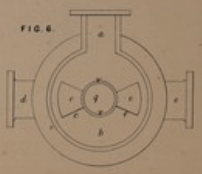


FIG. 7.

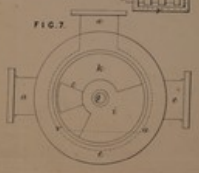


FIG. 8.

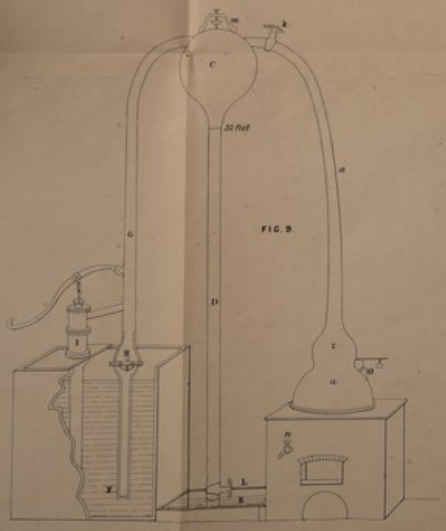


FIG. 9.

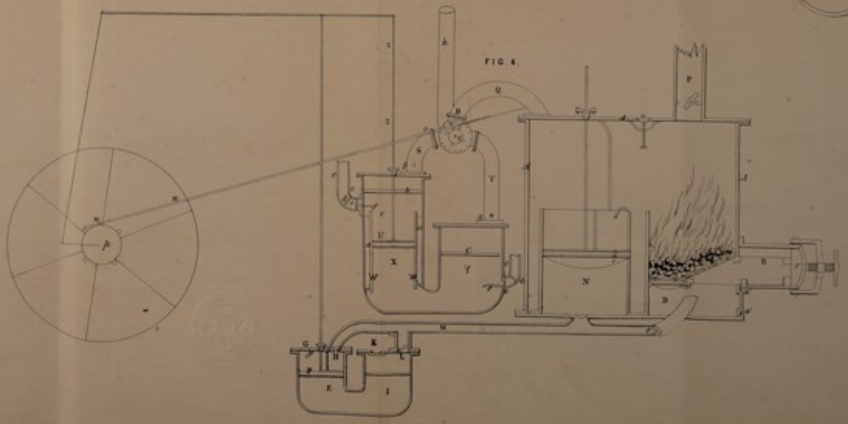


FIG. 4.

The certified drawing is partly altered.

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equipped with a cock, in order to regulate the velicity of discharge to the degree of cooling that may be required; and the reservoir T should be as capacious as convenient in order to afford a constant supply of cold water; but in situations where a large reservoir may be objectionable, or where time cannot be afforded for the spontaneous cooling of such water, I place a series of flat pipes just under the surface of the water in the reservoir, as shewn at W, one end or extremity of such pipes being left open and made to turn up into the air, while the opposite ends or extremities pass into one common pipe that goes into the flue or chimney of the boiler P, or any other chimney, the consequence of which is that the heat of the water in the reservoir and the draft of the chimney combined will always produce a current of cold air through the flat pipes disposed as aforesaid, which will have a very powerful effect in cooling the water in which they are so immersed. For the purpose of distilling, I use and apply the refrigerator and apparatus last above described, with the exception only that steam enters the pipe Q instead of the hot liquor, and as I confine my process to distilling in vacuo, or in rarefied air, so the discharging pipe must descend perpendicularly for about thirty-five feet; and in order to produce the first vacuum I fill the whole interior of the flat boxes and pipes of my refrigitory as aforesaid with water, and permit it to run off as before described, or I draw such water off by the application of an ordinary pump or exhausting syringe to some convenient part of the said refrigitory. In describing the several parts of my aforesaid Invention and improvements, I have purposely avoided the statement of dimensions, unless when they were absolutely necessary to the action of the same, because such dimensions and proportions must vary with the circumstances under which the same may be formed and constructed. And in the description of the air engine, evaporating apparatus, and refrigeratory, I have also been general as to form, because my Invention does not consist in the particular forms or proportions of the matters and things described, but in the general combination and arrangement of pistons, cylinders, tubes, valves, and other well known mechanical agents for the production of new and beneficial purposes to which such things have not been so employed before, or at any rate in so efficient and beneficial a manner; and I accordingly claim the arrangements and appropriations herein-before described to be made, and the inventions and improvements alluded to in the herein-before in part recited Patent.

In witness whereof, I, the said Neil Arnott (party hereto), have hereunto set my hand and seal, this Fourteenth day of May, in the year of our Lord One thousand eight hundred and twenty-two.

NEIL (L.S.) ARNOTT.

COURTENAY.

AND BE IT REMEMBERED, that on the Fourteenth day of May, in the year of our Lord 1822, the aforesaid Neil Arnott came before our said Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained and specified, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute made for that purpose.

Inrolled the Fourteenth day of May, in the year of our Lord One thousand eight hundred and twenty-two.

LONDON:
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Printers to the Queen's most Excellent Majesty. 1854.