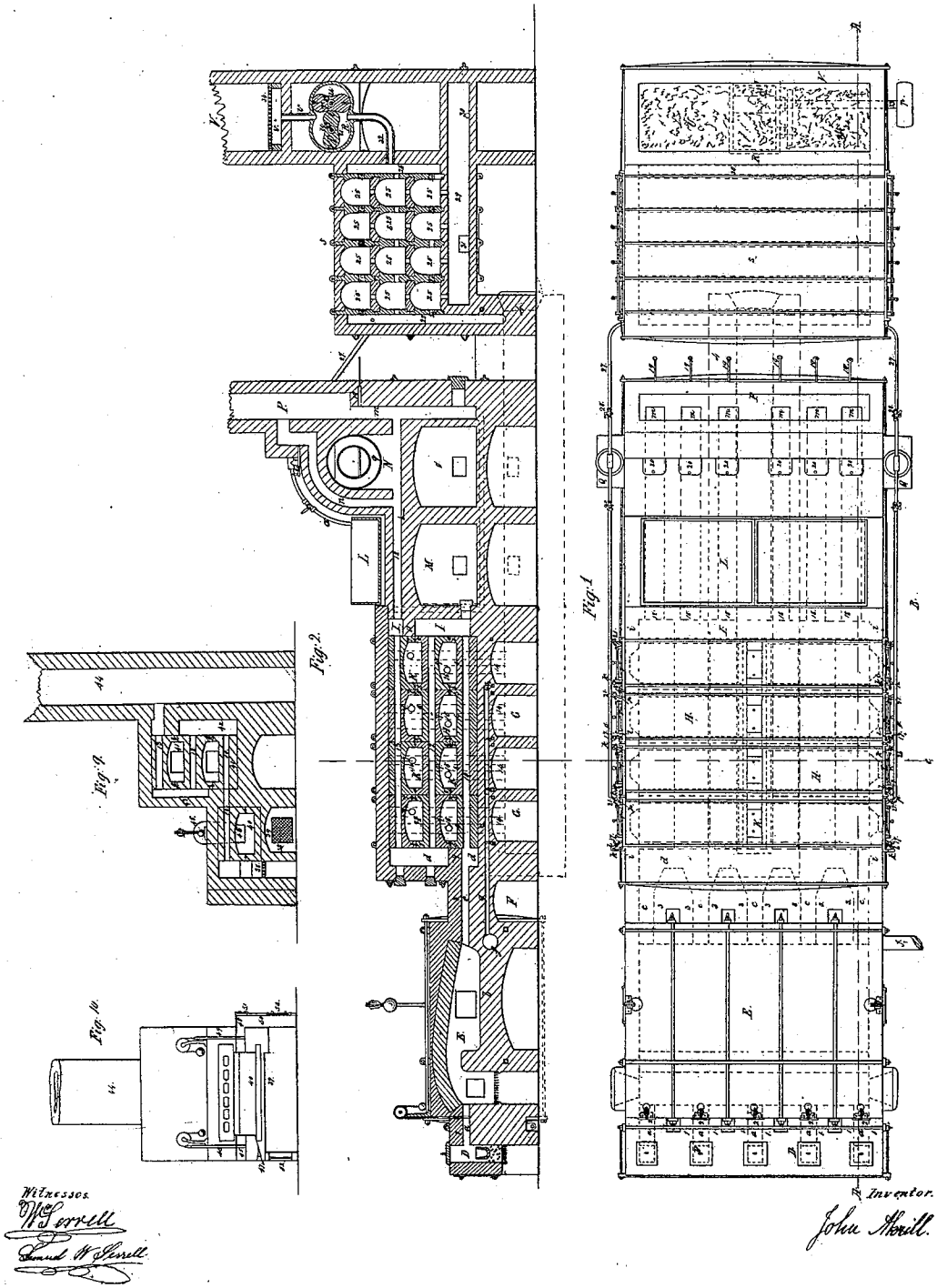
2 Sheets—Sheet 1.

J. AKRILL.

CONSTRUCTION OF RETORTS FOR CHEMICAL FURNACES.

No. 8,993. Patented June 8, 1852.



Witnesses.
W. H. Sorrell
Daniel W. Sorrell

Inventor.
John Akrill.

2 Sheets—Sheet 2.

J. AKRILL.

CONSTRUCTION OF RETORTS FOR CHEMICAL FURNACES.

No. 8,993. Patented June 8, 1852.

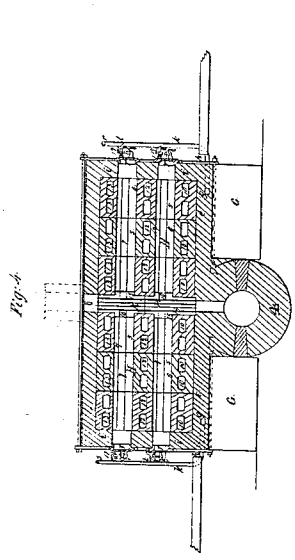


Fig. 4.

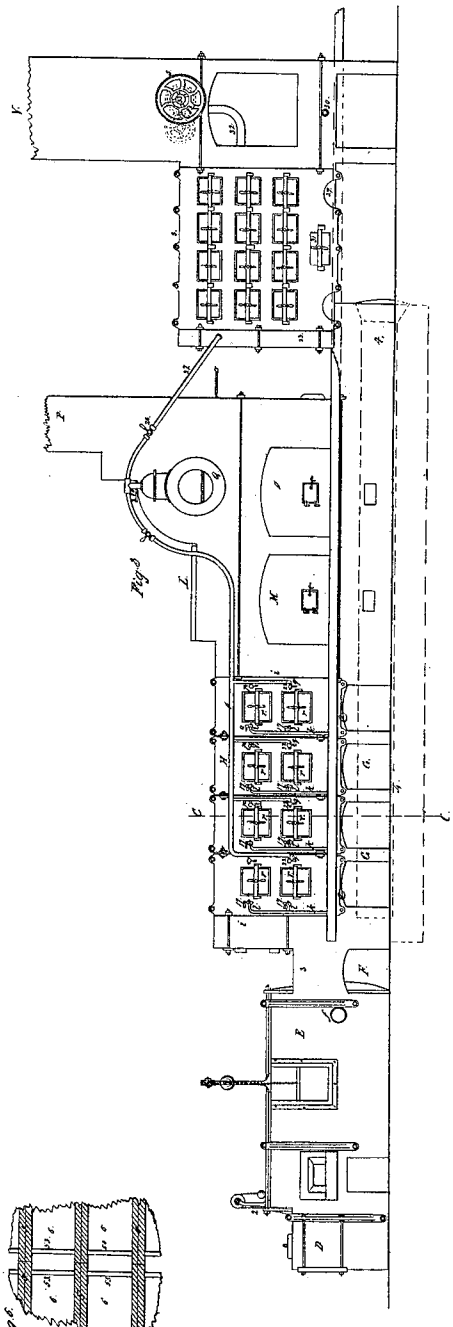


Fig. 5.

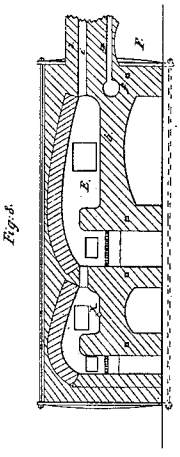


Fig. 5.

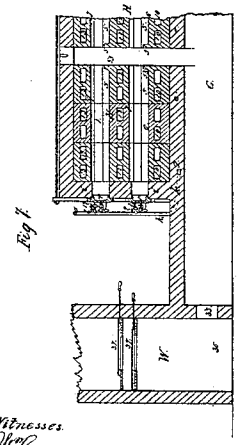


Fig. 1.

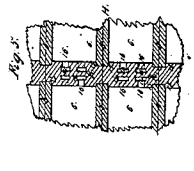


Fig. 3.

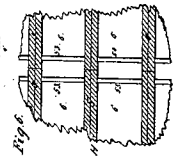


Fig. 6.

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Wm. Serrell
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JOHN AKRILL, OF WILLIAMSBURG, NEW YORK.

IMPROVEMENT IN THE CONSTRUCTION OF RETORTS FOR CHEMICAL FURNACES.

Specification forming part of Letters Patent No. **8,993**, dated June 8, 1852.

To all whom it may concern:

Be it known that I, JOHN AKRILL, of Williamsburg, Kings county, State of New York, (manufacturer,) have invented, made, and applied to use certain new and useful Improvements in the Construction of Retorts, which I have arranged and applied with furnaces and chambers, expressly as the means to effect all the following operations: first, the conversion of metallic zinc into white oxide of zinc for use as a paint or pigment; second, the obtaining hydrogen gas for illumination from metallic zinc and sulphuric acid, and converting the sulphate of zinc formed by the process into white oxide; third, the calcination of sulphureted ores, and the conversion of the evolved sulphurous gases to profitable uses; fourth, the conversion of ores of copper into the metallic form; fifth, the formation of oxides of lead; sixth, the sublimation of sulphur and condensing the gas evolved for any use; seventh, the production of gas for illumination from any usual materials, and the conversion of the ammoniacal residuum into the liquid ammonia of commerce; eighth, the deoxidizing oxidous ores of metal previous to conversion into the metallic form; ninth, the destructive distillation of animal, earthy, and vegetable matters for conversion into charcoal, and the conversion of the expelled ammoniacal vapors into the liquid ammonia of commerce; tenth, the mixing of copper with zinc or other alloys to form common brass, with a means to save the vapor of the zinc and condense it into oxide; eleventh, the annealing of metals, glass, &c. It is to be distinctly understood that no one of these processes is new in itself, and is expressly disclaimed as such herein, the intent of these improvements being simply to effect these several processes by new and economical means. These objects are attained by a peculiar arrangement of pot-furnaces or refinery-furnaces and reverberatory or puddling furnaces, or any effective furnace acting to heat retorts, evaporators, boilers, and kilns or ovens, with chambers for receiving metallic zinc or ore of zinc or other material to be operated on by sulphurous gas, water, and steam, such chambers having attached a peculiar form of mechanical exhaustion to effect a draft in and through all the several preceding parts, which are used primarily, successively, continuously, and combined in a manner for which I seek Letters Patent of the United States, and that the construction, arrangement, and operation of the means by which these several consecutive and combined operations are effected are fully and substantially set forth and shown in the following description, and in the drawings annexed to and making part of this my specification of my said improvements, wherein—

Figure 1 is a general plan of all the parts in place, with the position of some of the parts beneath denoted by dotted lines. Fig. 2 is a sectional elevation through the line A A of Fig. 1, the vertical flues to carry off the vapor from the retorts being denoted by dotted lines. Fig. 3 is a general exterior elevation on the side B of Fig. 1. Fig. 4 is a cross-section through the line *c c* of Figs. 1, 2, and 3 of a nest of four retorts, showing the horizontal flues that conduct the fire heat below and above each retort. Fig. 5 is a plan showing the construction of the dividing-piers between each two retorts, with vertical flues connected one to each retort. Fig. 6 is a plan at the inner end of retorts, fitted to carry down the oxide of zinc in vapor or the vapor of sulphur in sublimation. This mode of fitting the retorts may be inverted, and have connections to upper horizontal flues to carry off the sulphurous gases evolved in calcining metals or other gases in the opposite direction if needful. Fig. 7 is a sectional elevation of an extended arch to condense the vapors of sublimation or the oxides of metals in vapor. The other detached figures are separately referred to, and the like letters and numbers as marks of reference apply to the same parts in each of the figures, as follows:

D D are pot-furnaces, built in the usual manner, but set at an elevation to lead the heat by flues *a*, formed by divisions 1 1, each with a damper, 2, into the fire-chamber of the reverberatory furnace E, which may be used for melting, puddling, or refining metal, the fire acting on the material on the bed *b* conjointly with the surplus heat from the pot-furnaces. The heat from the furnace E is carried on by exit-flues *c*, formed by small piers 3 (shown by dotted lines in Fig. 1) that support the end arch of the furnace. These flues continue over an arch, F, into a chamber, *d*.

G G are piers and arches filled in to form a level platform of masonry, *e e*, above the

arches, built with a central flue or barrel arch, 4, shown in Fig. 4, and by dotted lines in Figs. 1, 2, and 3, as passing on the bases of the piers.

f is a pipe across through the masonry near the exit of the furnace E, opening into lengthwise pipes *g g*, formed or laid in the masonry over the arches G, and connecting at their sides into cross-pipes *h*, extending outside the masonry. The pipe *f* is to be connected at either end to any blower competent to drive a blast through all the pipes, for a purpose shown hereinafter.

H H is a double range of retorts on the platform *e*, each shown as made of clay in three sections, but may be any number of sections or parts, or may be made of iron, as hereinafter stated.

i i are the walls at each outer end of the retorts and furnaces, and 5 (see Figs. 2 and 4) are the sides of the lower half of each retort that inclose the hearth 6.

7 is the crown and legs forming the upper half of each retort and covering the hearth.

8 is a groove formed one half in the upper sides, 5, of the hearth-pieces, and one half on the under side of the legs 7, to introduce any proper luting that will effectively close the joints between the two parts.

In the flue-chamber *d* a stop, 9, directs the fire heat into the flues 10, under the hearths of the lower range of retorts H H, where the heat, acting and passing through the whole range, enters the lower part of the vertical flue I at the farther end of the range, in which a stop, 11, turns the current of heat back into and through the second tier of flues, 12, above the crowns of the lower retorts and under the hearths of the upper range of retorts, into the part of the chamber *d* above the stop 9, which passes the current into the flues 13 through the crowns of the upper range of retorts and into the part of the flue I above the stop 11.

K K are piers of the same material as the retorts, each having vertical flues 14, so fitted that each flue communicates with one retort by an opening, 16. Each pier is made with projecting faces on each side to enter the retorts by rabbets 15, fitted to receive the inner ends of the retort and form a close joint all round by any proper luting. The vertical flues 14 are closed on their upper ends by stoppers or other means that can be removed to clean out the flues, and the lower ends of these vertical flues descend to openings through and into the barrel-arch 4, to lead the gaseous products of the retorts away for use, as hereinafter shown.

The heat acquired by the masonry when in use heats the air in its passage from the principal pipe *f*. The retorts are covered over with brick-work or any similar substance and are tied together by plates and tie-bars in any convenient manner.

At *k k* are vertical pipes from the air-pipes *h*, with branches *l*, one opening into each retort, the access and quantity of air allowed to pass into the retort being regulated by cocks 17. At 18 the flue 13 opens into a horizontal flue passing under the evaporating-pans L and above the arch M, which is used for a purpose hereinafter shown. After the current of fire heat has passed under the evaporating-pans it passes into the chamber N over the arch O, which chamber N contains a boiler, Q, that is heated by the current of heat beneath it when the heat is so used. The current in this case passes off by the flue *m* into the chimney P, and a furnace may be made in the boiler, if found needful; but if the steam from the boiler is not in use for the precedent and subsequent operations, the dampers 19 are set to close the flues *m* to the chimney. In this case the draft and current of heat pass by the auxiliary flue *n* over the boiler and into the chimney P, the dampers 20 being open to pass the draft when the dampers 19 are shut, or the reverse if the heat is to operate on the boiler.

At *o o* are steam-pipes from each end of the boiler, passing along at each end of the two tiers of retorts, having branches *p p* and cocks 21 for passing a regulated supply of steam into the upper retorts H H and lower branches, *q q*, and cocks 22, (see Fig. 3,) to supply steam to the lower tier of retorts. At *r r* are doors, of any usual form, to open and close the retorts H. When the retorts are used to calcine the sulphureted ores of metals, the arch or barrel 4 is to be continued, as shown in Figs. 1, 2, and 3, to the vertical flue 23, Figs. 1 and 2, which receives a regulated amount of steam through the pipes 27 and cocks 28, and this flue communicates by side openings, 24, to the chambers 25 of the nest of chambers S, (shown in plan in Fig. 1 and in longitudinal sectional elevation in Fig. 2,) and arranged to pass the sulphurous or other gas with steam from the pipes 27, if required, over any material on the floors of the chambers 25, and convert the materials into their respective compounds, the gas passing through all the chambers into a vertical cross-flue, 26. The floors of the chambers 25 are perforated to pass any condensation or liquid matter into the chamber 29, whence it may be removed by a pipe, 30, or by the door 31. The vertical cross-flue 26 is connected by a pipe, 32, to the exhausting pump or blower R, made as shown in Fig. 2, the pipe 32 passing into the semi-circular-ended case having two covers fitted to receive two arbors, 33, on one end of each of which is a tooth-wheel. These gear together, and on the end of one arbor 33 is a drum, *s*, to communicate any competent power and rotate the arbors 33 and tooth-wheels. These arbors carry within the case R a pair of rotary valves, T, formed in a shape approximating that of the numeral 8, but so proportioned and set that as they rotate with the arbors 33 the convex parts *t* of each pass into the concave parts *u* of the other, the operation being that the portion of sulphurous or other gas in surplus from the precedent operations and coming from the last flue by the pipe 32, is partially

drawn in on the entering side by the rotation of the valves T T, and carried round to the exit-nozzle *v*, by which the gas escapes or is forced into a shallow chamber, U, beneath a grating or perforated floor, 34, which may sustain any articles that can be advantageously treated with or operated on by the sulphurous gas, which afterward finally passes off by the chimney V.

In the construction and arrangement of the parts, as before described, it will be seen that what is ordinarily the waste heat from the first furnaces, D D, goes by the flues *a a* to augment the heat in the reverberatory furnace E, and that the conjoined heat, which is now often allowed to escape up a chimney, is led through the flues *c* and 10, under the hearths of the lower range of retorts H, through the flues 12, between the crowns of the lower tier and the hearths of the second tier, then by the flues 13 over the crowns of the upper tier, by this means heating the whole of the retorts to a high temperature without the current of fire heat coming in contact with the contents of the retorts, these contents being thus subjected to the action of confined and quiescent heat, without being affected by the operation of a current of heat containing oxygen or other gases to interfere with the operations of the heat on the articles under treatment. The current of unexpended heat, passing from the extremity of the flue 13 by the upper part of the flue I, goes through the flues 18 under the evaporating-pans L, and heating these evaporates the aqueous contents to any required degree, thence passing by the flues into the chamber N to heat the water in the boiler Q for use, as herein shown. By this arrangement the greater part of what has hitherto been waste heat from the furnaces D and E is applied to useful purposes.

The construction and arrangement of the parts having been thus specified the uses of them are now to be described. The first space between the first furnaces, D, and the reverberatory furnace E and the arch F between that and the retorts are merely to connect the parts and carry the flues so as to allow access for repairing or rebuilding either furnace without disturbing the nest of retorts H, and are mere matters of practical convenience. The barrel-arch 4 beneath, running through and at right angles with the foundation of the piers, is to be used for receiving gases from the retorts, and conveying them to the chamber S as it receives them by the continuations downward of the vertical flues 14 in the dividing-piers K, and this arch 4 may also be used in like manner for a variety of other purposes hereinafter set forth.

The large arch M under the evaporating-pans L, and the arch O under the boiler N may be used as kilns or ovens, and in these the retorts themselves may be dried and baked for use, or any other articles may be dried and baked by the surplus heat from the retorts, or by auxiliary fires beneath or in the arches, or the heat from the retorts may be made to operate in conjunction with the auxiliary fires, and when the evaporating-pans are not wanted to be used the heat may be carried down on one side and beneath the floors of the arches, and up on the opposite side, as shown by dotted lines in Fig. 2, the current of heat being regulated by dampers in any usual way.

The materials of these retorts and the means for and manner of making them preparatory to drying and using them will probably form the subject of a separate patent hereafter, as being a separate invention. Therefore these details are not given herein.

The original intention in these improvements was to produce or form the white oxide of zinc for use as a paint or pigment, by either burning the metallic zinc, and condensing the vapor, or by treating the sulphate of zinc produced by the action of sulphuric acid and water on metallic zinc, so as to convert this into a white oxide, and also have the hydrogen gas for use. The first process will now be described. Any or all of the retorts may be used for this purpose, and are to be fitted with openings in the place of the flue-piers K, as shown in Figs. 6 and 7, with lips 53 across the inner end of each hearth, and the arches G below made to extend to the center, and without the barrel-arch or horizontal flue 4 running through them. These arches G thus made continuous may be lengthened at either end, as shown in Fig. 7, and coated inside with any cement that will form a smooth surface on the crowns, sides, and floors. The outer end or ends of these arches are to be connected by an opening, 35, into one side of a cold chimney, W, of any proper size to form a chamber, 36, and above this the chimney is to be fitted to carry one or more wire or cloth screens, 37, so fitted as to shake horizontally by a handle, and above these an exhausting-pump is to be fitted exactly similar to the one already described as placed in the chimney V, and used in the same manner to form a suction-draft from the retorts H through the openings between the ends of each two hearths, and through the lengthened arches G to the chimney W. The operation and effect of this arrangement consequent on the mode of constructing the retorts and using the heat is that when the retorts are heated to a white heat, the metallic zinc when put in is soon brought to a volatilizing or white heat in the retorts and steam or hot air, or both, let in by the cocks 17 or 21 22. The metal unites with these in the form of a vapory oxide, and descending through the openings between each hearth by the suction-draft in the chimney W, the vapor is condensed in the chambers formed by the arches G, the floccules are retained by the screens 37, and shaken down into the chamber 36 in a state of white oxide fit for use as a paint. In this mode of constructing and using the retorts, flues, and arches, any portion of the oxides that

may condense upon and adhere to their surfaces may be removed in any convenient manner.

The principal objection to the use of hydrogen gas for any purpose, when evolved from metallic zinc by sulphuric acid and water, is believed to be that in this or any similar known process the cost of the gas is enhanced by the fact that the sulphate of zinc, which is the result of this process, has not hitherto been converted to any profitable use. This mode of producing hydrogen gas is well known, and forms no part of the invention hereinafter claimed; but the mode of making profit from the sulphate of zinc, which is the result of the process, is next to be stated as connected with the apparatus herein described and shown. Metallic zinc in any usual proportions is to be placed in dilute sulphuric acid, and the hydrogen gas evolved by this operation is to be applied to any useful purpose in any usual manner. For this part of the process any one or more of the arches G that are not otherwise used, is to have a competent tight tank fitted into it, to contain the dilute sulphuric acid and zinc, with a pipe to conduct the hydrogen gas into one of the retorts for carbonization, as is hereinafter described, or may be conducted away in any other direction for any other purpose. The sulphate of zinc, which is the result of this process, is to be placed in the evaporating-pans L and heated by the heat passing under the pans in the flue or flues 18, and chloride of lime is to be introduced to oxidize any iron that may be present. The liquid is then to be decanted into other similar vessels and allowed to settle and precipitate the oxide of iron or other foreign substances, after which the liquid is to be decanted into a third set of vessels and treated with ammonia or other alkaline substances. These combine with the sulphuric acid and liberate the zinc, which falls to the bottom of the vessel in the form of an oxide. The sulphate is then to be decanted off as much as possible. These decantings may be effected by siphon-pipes and cocks, or by any usual means. The zinc which has fallen to the bottom of the third set of vessels as an oxide or hydrate, is to be taken out and placed in strong sacking bags and pressed by a hydraulic press, or any competent press, to drive out as much as possible of the sulphate that may remain in the mass, which is then to be placed in clean water, into which steam is to be introduced, and the mass stirred and agitated in several washings, that the water may carry off as much as it will absorb of any remaining sulphate. When sufficiently washed, as much of the water used as possible is to be decanted off and the zinc taken out and repressed, as before, and then taken in the masses formed by the second pressing and placed in one of the retorts and heated to a white heat for the twofold purpose of expelling the aqueous matter and driving out any remaining traces of the sulphate. In this process the flues 14 must be closed, and the vapors expelled by the heat must be allowed to escape by not entirely closing the door of the retort, or by a regulated aperture in the door. When nearly or quite at white heat, the aqueous and foreign vapors will be expelled and the masses be in the condition of a white oxide of zinc, which is to be taken out and allowed to cool, and will be in a fit state for use as a paint or pigment in any usual manner.

In this process any ores of zinc, wastages containing zinc, or any drosses of zinc may be used; and after producing the hydrogen gas the sulphate may be converted into white oxide, and the several mixtures of materials used in the process may be reserved and treated so as to avoid waste of the ammonia (if ammonia is used) by evaporation, as usual, and using it over again; and by appropriating one portion of the retorts to the first process of oxidizing the metal, and a second portion to burning the hydrate or oxide, a third portion of the retorts may be appropriated to receive the hydrogen gas evolved in the second process, and carbonize it by combination with any proper material in the retort, whence the gas may be allowed to pass either up or down by the flues 14, and conveyed to a gasometer, in the usual way, for use in illumination.

The next use to which these retorts H H are to be applied is the calcination of sulphureted ores of metals, and when so employed the ores under treatment are subjected to any required degree of heat in the presence of a regulated supply of steam and hot air, by the cocks 21, 22, or 17, the sulphurous gases evolved in the process going off by the flues 14 and barrel-arch 4 to the chambers S, as before described. If these retorts are applied to preparing sulphureted ores of copper for conversion into the metallic state, the ores are first to be calcined in one or more of the retorts with the door closed, and steam or hot air, or both, are to be passed in by the cocks, as described, the sulphurous gas going off by the flues 14 and arch 4 to be used in any of the modes herein described. When sufficiently calcined, the ores are to be taken to the reverberatory furnace E and reduced as usual, and then taken to the retorts and subjected to the same treatment as before, after which they are to be taken through the reverberatory or smelting furnace and through the refinery working in the usual manner, the main points of the application and arrangement of the retorts and furnaces being, first, that by the retorts H H the sulphurous gases evolved are made useful in the manner described; and, second, that the first or calcining operations are effected by what is ordinarily the wasted heat from the first and second furnaces acting through the retorts on the ores under treatment, so that the operations of calcining, smelting, and refining can all be in progress by the same fires. The mode of effecting all these processes by the furnace-fires is shown in the detached Fig. 8, where *x*

is the refining-furnace acting with the reverberatory furnace E, the conjoined surplus heat going off to heat the retorts by the flues *c*.

In forming oxides of lead for any use, the metal is to be oxidized in either of the first furnaces, X or E, by the fires and by hot air and steam from the pipes *o* and *k*, after which the oxides so formed are to be burned in the retorts, then ground and floated in the usual manner, then returned to the retorts to be formed into litharge or red lead by the more brief or more lengthened operation of the heat and heated air when red lead is to be formed. These processes are to be conducted as in the ordinary manner, the same advantages being derived from the construction of the retorts and the use of the waste heat from the first furnaces, as is shown in the other operations herein described. It will be understood that in thus working lead the flues 14 will not be needed. The other uses to which the apparatus may be applied are as follows:

The sulphurous gases evolved in any of the former processes, or the gases evolved in the sublimation of sulphur in the retorts, may be taken by the flues 14 and barrel-arch 4 to condensing-chambers, by connections of any proper kind, and condensed to form the sulphur of commerce, or the gases may be converted into sulphuric acid by the usual known means, and the acid may be used for converting the ores or metal of zinc into sulphate of zinc, by placing either of them in the same chamber where the acid is formed, the hydrogen gas evolved being used as described.

The retorts may be used for producing gas for illumination from coals or other fit materials, and when so employed a portion of the retorts may be used to vaporize the ammoniacal residuum of the process, by heating the mass and conveying away the vapor for condensation to form the liquid ammonia of commerce, by any convenient or usual means. Oxidous ores of metal may be deoxidized in these retorts preparatory to the subsequent processes, for conversion into metallic forms by either or both of the first furnaces.

Vegetable materials of any kind may be subjected to destructive distillation in these retorts, and the gaseous products be taken off for use upward by the flues 14, or downward by these and the arch 4. The matter left in the retorts, being converted into charcoal and bones or peat, may be reduced to bone-black or charcoal. The ammoniacal vapor from either of these may be taken off by any convenient means for condensation into liquid ammonia.

The detached Figs. 9 and 10 are a lengthwise and cross section of an arrangement by which retorts of this character may be applied to the conversion of copper and zinc into brass, with the advantages of saving the vapor of the zinc which sublimes in the mixing, and condensing it into white oxide, and of using the secondary or now wasted heat of the fire to anneal the brass in the several stages of rolling or working it. In these figures, 38 is the furnace, set on one side of an arch, 39, which supports a melting-retort, 40, having no flue under the hearth, but flues 12 in the crown of the retort 40, which open into the flue 10 under the hearth of the lower one of two annealing-retorts, 41. The heat passes into a chamber, 42, which directs the heat into the flues 12 above the crown of the lower and under the hearth of the upper retort, into a chamber, 43, whence the heat passes by the upper flues, 13, over the crown of the upper retort, into the chimney 44.

At 45 is the feeding-door in front of the retort 40, and 46 is a damper or sliding door, as usual.

47 is the top hole and plug to let out melted metal.

48 is an opening at the back end of the retort 40, with a damper or sliding door, 49, to regulate the exit of the gaseous vapor from the zinc into a descending flue, 50, with a door, 51. The flue 50 opens into the arch 39, which is to be fitted with a door, 52, at each end, of cloth or gauze to retain the floccules of the gaseous vapor from the zinc. By this arrangement the copper to form brass is melted in the retort 40, and the zinc added, as usual, with the slide 49 open. The vapor of the zinc goes off by the opening 48, and is condensed in the arch 39 into a white oxide that may be taken out for use. The retorts 41, heated by the surplus heat, will anneal the brass when made to permit successive rollings in the manufacture, as usual, and this arrangement is equally available for refining copper and annealing it in the process of rolling; or iron melted in the furnaces and cast into form may be annealed in the same way.

Metals, glass, or other materials may be annealed and other substances heated or baked in these retorts.

If any one retort becomes damaged in use, it can be removed and another put in by merely removing the wall and door in front instead of disturbing the whole nest or pile, and if it is intended to use the arrangement to produce gas for illumination, the retorts H and flue-piers K may be made of iron and arranged in the same manner, so as to be equally effective; and in some cases it may be useful to put in the lower flue-pier, K, only, and allow two flues to open at the bottom of the top tier, so that the operations going on in the top retorts may be seen all through by merely opening both doors of the two top retorts. In this case a cross-lip, 53, may be placed at the inner end of each top retort, as shown in Fig. 7, to rise a little above the hearth, and prevent any substance falling into the descending flues 14.

If the retorts are applied to subliming sulphur or any similar operation, the lower flue-pier, K, may be left out, and the upper kept in, as by thus reversing these positions the gases evolved may be taken upward from each four retorts by the flues 14, into any proper

reservoir or chamber for ulterior operations; or if the sulphurous gases are taken downward, the barrel-arch 4 may be tapped laterally by pipes to lead the gas into any proper vessel in the arches G for the production of sulphuric acid by the usual means.

Having described the construction, operation, uses, and effects of my invention, and arrangements by which it will be seen that what is ordinarily wasted heat from any principal furnace or furnaces is by these arrangements made effectively available for a great variety of purposes, and that these ends are attained not by so applying such waste heat in any ordinary manner, but by using the herein-described new form and arrangement of retorts and flues, first, to use the heat, and second, to carry off and make useful a variety of gaseous products that are now deemed useless and noxious, and preventing these from coming in contact with the fire; and having stated various uses to which these improvements are applicable, so far as I now know of such uses, I do not mean to confine or limit myself to the described uses or to the number of retorts shown in the drawings, but to apply these improvements to any and all purposes, in any number and in any manner in which they may be found available, by varying the mechanical details to suit particular purposes.

I am aware that I have herein described many and various uses to which these retorts are applicable; but these uses are merely detailed herein to illustrate the advantages and conveniences of my retorts, and to enable others to arrange the additional parts necessary in their various applications.

It will be seen that these retorts may be heated by any proper fire, whether it is the waste heat of a furnace or a separate fire.

The main features of my invention are, the forming retorts in one or more pieces, so that they set together without needing masonry-work to form the flues, and each retort is supported and kept from warping or getting out of shape by its square form, making of any number, as it were, one solid piece, with all the necessary flues, and at the same time, if a retort wears out, all that is necessary is to put in a new one, which occupies the place of the old one, and forms its own flues without needing separate parts or masonry-work, which at all times is expensive, and cannot always be built in particular situations, is liable to get out of repair and requires much more space and greater thickness of the parts, whereas my retorts are comparatively light, compact, easily repaired, and withal very tight, and effective in use, and possess advantages consequent upon their peculiar construction, which I am not aware have ever before been obtained by any other form of retort.

I disclaim all processes to which these retorts are applicable, and all chemical compounds and mode of working the same, which are herein described, and I disclaim all the apparatus shown herein except as follows:

What I desire to secure by Letters Patent is—

The retorts H, formed by the arch 7 and bed 6, with the sides 5 5, and perforated with the cross-flues 10, 12, or 13, below the bed and above the arch of each retort, said retorts being formed and operating as herein set forth, and being used for any purpose for which they may be available.

In witness whereof I have hereunto set my signature this 4th day of March, 1851.

JOHN AKRILL.

Witnesses:

WM. SERRELL,

LEMUEL W. SERRELL.