A.D. 1829 N° 5833.

Warming Buildings.

H. C. & C. F. PRICE'S SPECIFICATION.

TO ALL TO WHOM THESE PRESENTS SHALL COME, we, HENRY CRUGER PRICE and CHARLES FOX PRICE, of the City of Bristol, Ironmongers, send greeting.

WHEREAS we did, by Petition, humbly represent to His most Excellent Majesty King George the Fourth that, after consideration, application, and expence, we had invented or found out "**AN IMPROVEMENT IN AND UPON CERTAIN APPARATUS ALREADY KNOWN FOR THE COMMUNICATING OF HEAT BY MEANS OF THE CIRCULATION OF A FLUID**," which Invention we believed would be of general benefit and advantage, and that we were the true and first Inventors thereof, and that the same had not been made or used by any person or persons whatsoever to the best of our knowledge or belief; and His said Majesty being willing to encourage all useful inventions, was thereupon graciously pleased to grant us His Royal Letters Patent under the Great Seal of Great Britain, bearing date at Westminster, the Twentieth day of August, in the tenth year of His reign, and by those Letters Patent His said Majesty hath, for Himself, His heirs and successors, given and granted unto us, the said Henry Cruger Price and Charles Fox Price, our executors, administrators, and assigns, His especial licence, sole privilege and authority, that we or they, by ourselves or themselves, or by our or their deputy or deputies, servants or agents, or such others as we, the said Henry Cruger Price and Charles Fox Price, our executors, administrators, and assigns, shall at any time agree with (and no others), from time to time and at all times during the term of years therein expressed, shall and lawfully may make, use, exercise, and vend, within England, Wales, and the Town of Berwick-upon-Tweed, and also within His Majesty's Colonies and Plantations abroad, our said Invention, and have and enjoy the whole

profit and advantage thereof; in which said Letters Patent there is contained a proviso obliging us, the said Henry Cruger Price and Charles Fox Price, by an instrument in writing under our hands and seals (or under the hand and seal of one of us) particularly to describe and ascertain the nature of our said Invention, and in what manner the same is to be performed, and to cause the same to be enrolled in His Majesty's High Court of Chancery within six calendar months next and immediately after the date of the said recited Letters Patent, as in and by the same (reference being thereunto had) will more fully and at large appear.

NOW KNOW YE, that in compliance with the said proviso, I, the said Charles Fox Price, do hereby declare that the nature of our said Invention, and the manner in which the same is to be performed, is described and ascertained in manner following, that is to say:—

The apparatus to which our improvement relates is for the communicating of heat to air for the purpose of warming the interior of apartments in dwelling houses or shops, or manufactories, of churches and public edifices, of hot-houses and conservatories for plants, or other buildings in which a moderate degree of artificial heat or warmth is required to be given to the air therein contained, the communication of that heat being effected by means of the circulation of hot water through a system of pipes and hollow vessels, one of which vessels is situated at the lower part of the aparatus, and is exposed to the heat of fire in the manner of a boiler, in order to give heat to the water therein contained; and other hollow vessels, which are situated at the upper part of the apparatus, are surrounded with the air which is to be warmed by communicating to that air a part of the heat which the contained water received when the same was in the boiler. The said circulation is kept up in that direction which will always cause the water which is heated in the boiler to flow out from the upper part thereof through ascending pipes into the other pipes or vessels, which, as aforesaid, are exposed to the air; and as fast as the same water becomes cooled by communicating part of its heat to that air, it flows out from the said vessels through descending pipes, and returns into the lower part of the boiler, where it becomes heated again, and as fast as it is so heated it rises to the upper part of the boiler, and passes away again through the ascending pipes to the upper hollow vessels, as before stated, so as to keep up a continual circulation of all the water that is contained in the apparatus through every part of the system of pipes and hollow vessels, for the water goes out of the boiler as soon as it is heated by the fire that is applied thereto, and it returns back into the said boiler after it has become cooled within the vessels which are exposed to the air that is to be warmed by the apparatus.

The said circulation results from the manner in which the said boiler and pipes and hollow vessels are disposed, arranged, and combined, one with another, into a system whereof that part where the fire is applied is on a lower level than the other parts which are surrounded by the air that is to be warmed; and the ascending and descending connecting pipes between one part and the other of the apparatus are so arranged that the columns of water contained in each of the said pipes respectively shall be of equal vertical height, but nevertheless that the water constituting the column within the boiler (and the pipes ascending from it) shall be hotter than the water constituting the column within the vessels that are exposed to the air that is to be heated (and the pipes descending from them). In short, the apparatus must contain two distinct columns of water, one hotter than the other, which communicate freely at their respective lowest levels where the boiler is situated, and also at their highest levels, where the vessels that are exposed to the air are situated. The two columns are of equal vertical heights or altitudes; but the water in one column being colder (and consequently heavier) than the hotter water in the other column will preponderate and weigh up that other column, so as to cause motion and circulation of the water through the apparatus by virtue of those alterations of specific gravity which takes place in water or other fluids whenever they are heated or cooled. For instance, when heat is communicated to water so as to raise its temperature, the water expands, that is, its bulk or volume increases, and consequently the specific gravity of the water is diminished; for any given measure of it will weigh less than it would have weighed when the temperature was lower; or, on the other hand, when heat is withdrawn from water so as to lower its temperature, that water shrinks or contracts in bulk, and consequently its specific gravity is increased. On this principle, if one of the columns of water in the apparatus is always kept hot by the application of fire to the lowest part of it (that is under the boiler), and if the other column is always kept cool by the communication of part of its heat to the air that is to be warmed (that cooling taking place at the upper part of the column) then the greater specific gravity of the cooled water in the latter column will outweigh the hotter water in the other column so as to displace the hot water out of the boiler, and drive it upwards through the ascending pipes into the vessels which are exposed to the air as fast as the cooler water runs out therefrom through the descending pipes into the boiler, and the heated water so entering those upper vessels, being cooled in its turn, by communicating part of its heat to the surrounding air, becomes heavier, and then descends, forcing up out of the boiler a fresh quantity of water which has become heated again therein, and

consequently lightened, and thus the water in the boiler at the bottom of the two columns being continually heated by the fire, and the water in the upper vessels being continually cooled by warming the air with which they are surrounded, a constant circulation of the water is produced through all the parts of the apparatus, whereby that water becomes a vehicle for the conveyance and distribution of heat from the fire to places at a distance where that heat is required to be communicated to air. And whereas apparatus of the above description is already known, and is not of our Invention, it is not necessary to describe the same more minutely, what is herein-before stated being sufficient to explain the kind of apparatus to which our improvement is to be applied. And our improvement consists in a certain arrangement and combination of pipes and vessels (herein-after described) to be connected with the upper part of the ascending pipes from the boiler (which ascending pipes contain the column of heated water) in order to receive the increase which takes place in the volume of the water that is contained in the apparatus as it becomes heated, our improvement operating in such manner as to avoid overflowing by that increase, and yet to keep the boiler and the vessels which are exposed to the air which is to be warmed (as well as the ascending and descending pipes connecting between the same) always full of water. And further, our improvement consists in constructing the aforesaid vessels which are exposed to the air that is to be warmed in a particular manner (herein-after described) with several cylindrical vessels of different diameters, which are put one within another in pairs, the upper and lower edges of each pair being joined together, in order that the space left vacant between the two cylinders may form a vessel to contain the hot water. A series of such cylindrical vessels are disposed one within another, leaving narrow cylindrical spaces between them for the passage of the air that is to be warmed by the hot water which is contained within the vessels, consequently the said air will be exposed or spread out in thin layers, which are situated between extensive surfaces of the vessels containing the hot water, and, conversely, the hot water so contained will be spread out in thin layers between the said extensive surfaces that the vessels expose to the air, and that air is caused to ascend in a continuous current through the narrow cylindrical spaces allotted for it between the said cylindrical vessels, at the same time that the hot water flows downwards through the interior of the cylindrical vessels, whereby the heat of the water will be rapidly and completely communicated to the air. And for the full explanation of our improvements w have hereunto annexed a Drawing which represents so much of an apparatus for the communicating of heat to air by means of the circulation of hot water through the apparatus, as is requi-

site for the full explanation of our improvement, and the adaptation thereof to the apparatus already known.

Figure 1 is an elevation of the apparatus with our improvement. Figures 2, 3, and 4 are horizontal sections of what we term our water stove, being our aforesaid series of vessels one within another, by which the heat is communicated from the hot water to the air; and Figure 5 is a vertical section of the same stove. The same letters of reference are used to denote the same parts in all the Figures. A represents the boiler, which is of the kind commonly used for steam engines, and the only difference in the use of it is, that it is quite filled with water. The boiler is heated by applying fire to it in any of the modes in use for steam boilers; but the furnace is much smaller in proportion to the boiler than is usual in steam boilers. The construction of the boiler forming no part of our Invention need not be further described. B is an ascending pipe joined to the upper part of the boiler to convey the hot water therefrom up to the cylindrical vessel C. The ascending pipe B is no part of our Invention. The vessel C, with the pipes and vessels marked D, E, F, G, H, I, and K, we term our safety reservoir; and we claim the whole thereof as part of our Invention. The cylindrical vessel C is of such size as will facilitate the union of those pipes with it, and it also serves as a reservoir which contains an extra quantity of water beyond what would be absolutely necessary to the performance of the apparatus, and thereby allows hot water to be drawn off from the apparatus (when required for any useful purpose) without interrupting the operation of the apparatus. D is a pipe joined to the top of the vessel C, and to the bottom of the upper vessel E, in order to convey the increased and superfluous quantity of water (whether arising from the expansion of the water by heat or otherwise) from C into E. The pipe D is curved or looped down and up again to form an inverted syphon which will prevent the circulation of water that might otherwise take place between C and E, in consequence of the water contained in C (which is the lowest) being hotter than that contained in E (which is higher). E is a vessel in form of a frustrum of a cone, open at top, and the pipe D joins to it at bottom; it receives the water that may proceed from C, in consequence of the increase of the volume of the water contained in the apparatus when it becomes heated. As the vessel E is provided to allow for that expansion, its capacity should be made suitable to the increase of bulk consequent upon the application of heat. When the fluid employed is water, the capacity of the vessel E should be one twentieth part of the quantity of water contained in all the other parts of the apparatus, because water at the mean temperature of 52 degrees of Fahrenheit expands about one twentieth of its volume, when it

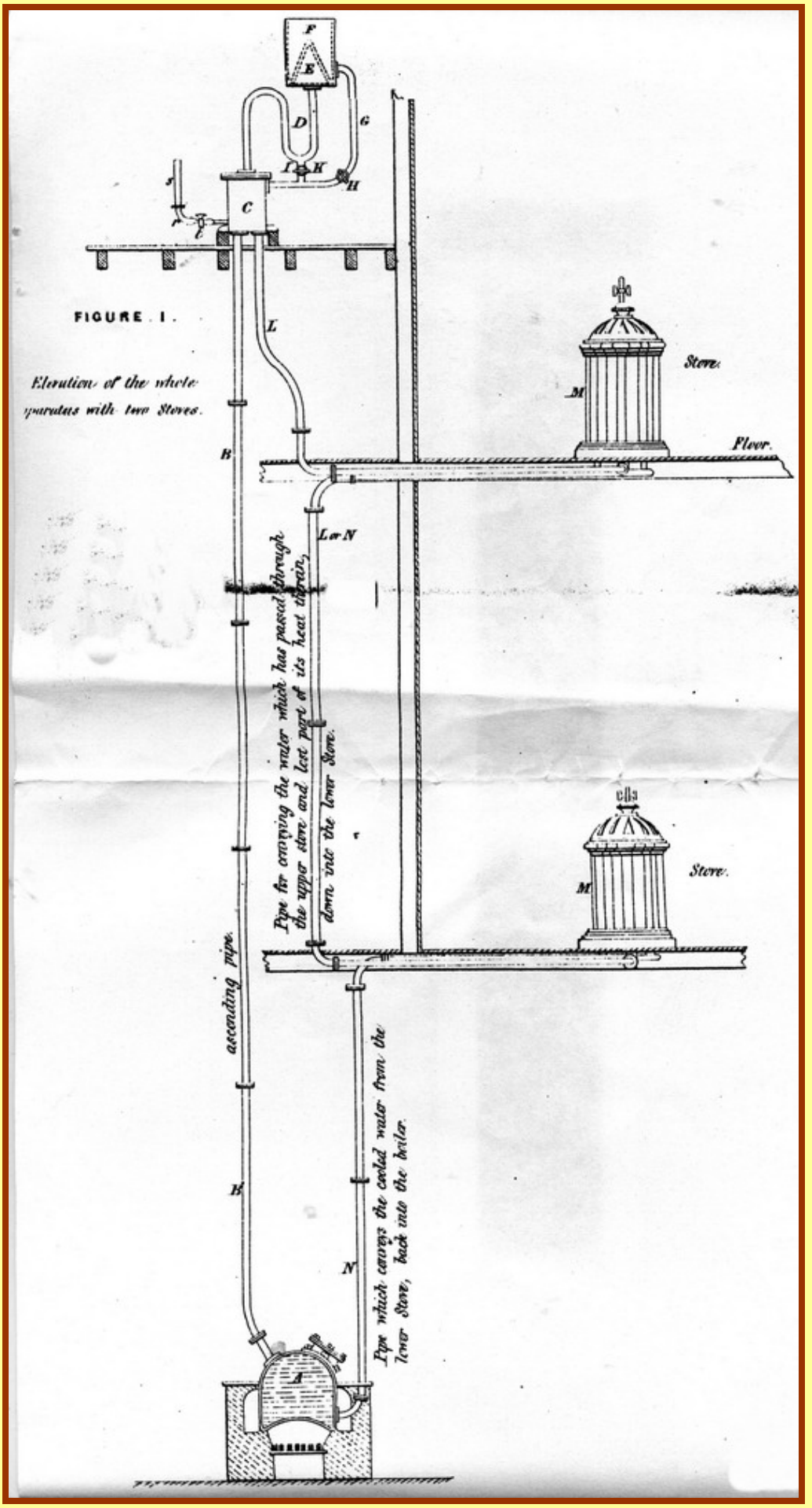

FIGURE. 1.

Elevation of the whole apparatus with two Stoves.

becomes heated to 212 degrees, or the boiling point. The vessel E is made conical, in order that as the water rises within it the extent of surface it exposes to the atmosphere may be diminished, and the evaporation proportionally lessened. F is a cylindrical vessel, within which the conical vessel E is contained, as it were, within a case. The vessel F is open at top, and its use is to receive such part of the water as may overflow the top of E in consequence of the generation of vapour in the boiler, or any other cause. The waste of water from the apparatus, whether by evaporation or by being withdrawn for usual purposes, or from other causes, may also be supplied by pouring water into the vessel F, and G is a pipe descending from F to C, with a stopcock in it at H to let down the water from F into C. I is a short pipe joined to the lower part of the loop in the pipe D, and to the pipe G, where it joins to the top of the vessel C. It has a stopcock K in it. When the cock K is opened, it allows the loop of D to empty itself of water, which might otherwise obstruct the escape of the air from the apparatus when it is to be filled preparatory to working. L is a pipe from the bottom of the vessel C to the bottom of our stove M. The pipe L is no part of our Invention.

M (see also Figures 2, 3, 4, and 5,) is our stove, which we do claim as part of our Invention. N is a pipe descending from the bottom of the stove M to the bottom of the boiler A: it serves to conduct the water down from the stove M (as it becomes cooled therein) to the boiler that it may be heated again. The pipe N we do not claim as our Invention. The vessel C should never be entirely empty, and to ascertain the height of the water within it a small vessel *s* is joined at the lower part of it by the pipe *r* and cock *t* to the bottom of the vessel C; therefore, when the cock *t* is opened (the cocks H or K being also opened to establish a free communication with the atmosphere) the water will rise within the vessel *s* to the same height as it stands within C. The vessel *s* is open at top, and that top is on a higher level than the top of C. *s* may be made of glass, to see the height of the water within it. The parts *r*, *s*, *t*, we do not claim as part of our Invention. The stove M is made of concentric cylinders, placed one within the other, leaving narrow spaces between the cylinders, which are united in pairs at top and at bottom, so that the space left between each pair will serve as a vessel to contain water, as is shewn by the coloured spaces *d*, *e*, in Figures 3 and 5. The spaces or intervals *f*, *f*, *f*, between the several cylinders *c*, *d*, *e*, that contain the water, are left vacant for the passage of the air that is to be warmed by the hot water that is contained within the vessels *c*, *d*, *e*. The cylindrical vessels *d*, *e*, of the stove are each composed of two cylinders of metal, which enter one within the other, leaving a space of about two inches

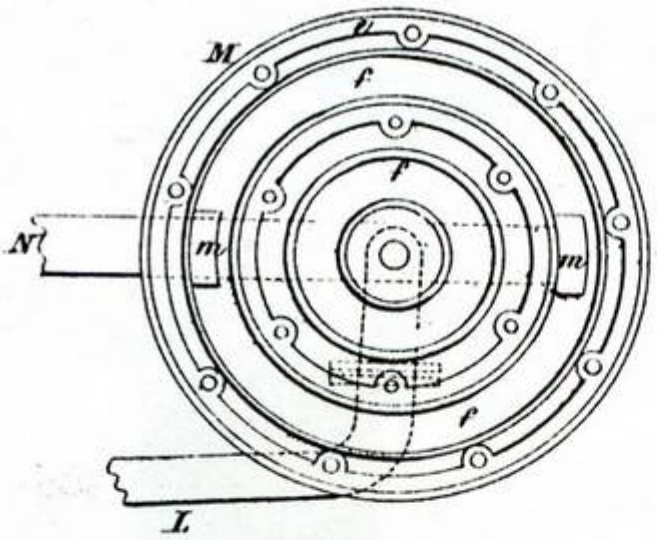

FIGURE . 2 .

Section of the Stove at the line 3 in Figure 5.

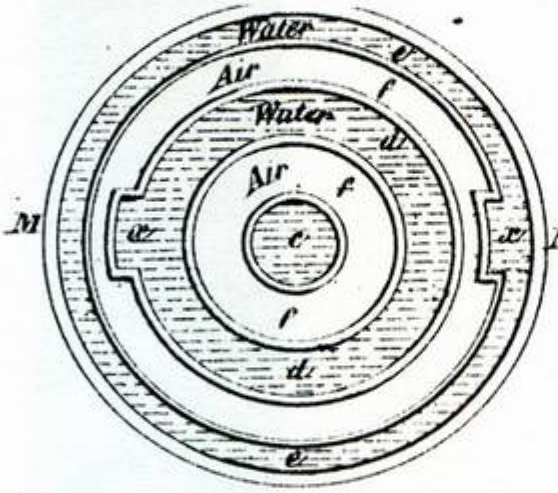

FIGURE . 3 .

Section of the Stove at the line 2 in Figure 5.

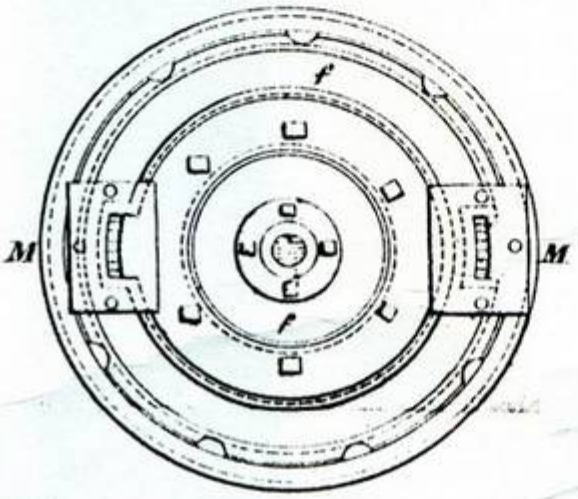

FIGURE . 4 .

Section of the Stove at the line 1 in Figure 5.

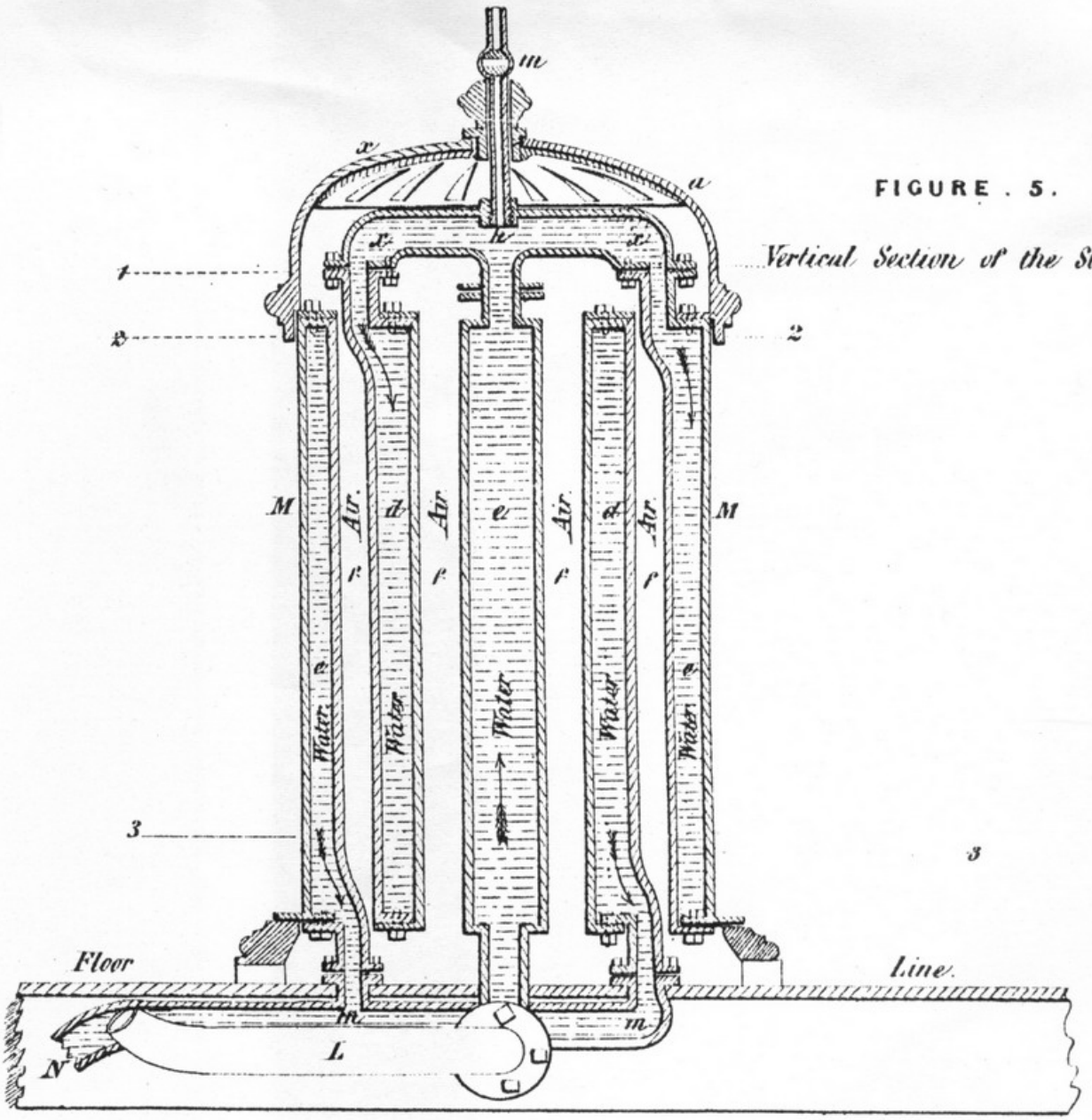

FIGURE . 5.

Vertical Section of the Stove.

Scale for Figures 2, 3, 4 and 5. 1 inch to the foot.

wide for water between the two cylinders, and they are united to each other by flanges at top and bottom of each, viz^t, the flange at the bottom of the smallest or interior cylinder projects outwards from the base thereof, whilst the lowest flange of the larger or external cylinder projects inwards therefrom, and the under surface of the latter flange applies upon the upper surface of the before-mentioned flange; suitable packing is interposed between the flanges, and they are united by screws put upwards through the lowest flange, and screwed into the other. In like manner the flange at the top of the inner cylinder projects outwards, whilst the upper flange of the outward cylinder projects inwards, but those upper flanges fit one into the other to form one plane, the outside circumference of the flange of the inner cylinder being of the same size and figure as the inside circumference of the flange of the exterior cylinder, and the crack between those two circumferences is covered by a flat circular ring applied over the top surface of the two flanges, with suitable packing under the ring, which is fastened down by screws put down through the ring, and tapped into the flanges. Note.—It is obvious that in order to put the cylinders together the lower flange of the outer cylinder must be large enough withinside to drop over the upper flange of the inner cylinder, but ears may project within the interior circle of the said lower flange of the outer cylinder to receive the screws, and corresponding indentations being made in the exterior edge of the upper flange of the inner cylinder, will allow one cylinder to drop over the other; also the interior of the upper flange of the outer cylinder must have ears projecting inwards to fill up the said indentations. Each of the vessels so formed of two cylinders has two necks projecting from it, viz^t, one at the bottom, projecting downwards to connect with the branches *m*, *m*, of the pipe N to convey the water away from the stove, and the other neck projecting upwards from the top to connect with the branches *x*, *x*, in order to introduce the hot water into the vessel. For this purpose the pipe L is joined to the bottom of the large pipe C, which stands up in the centre of the smallest of the vessels. That large pipe may be considered as a continuation of the pipe L, only enlarged in diameter, to form a small vessel, and expose more surface. An interval is left all round it for the passage of the air that is to be heated, and at the top of the vessel C the branch *x*, *x*, is joined to connect with the upper necks of the concentric vessels *d* and *e*, in order to introduce the hot water freely and equally into both them. Note.—The upper neck of each vessel, where the hot water is introduced into it, should be situated at that part of its interior capacity which is the most remote from the lower neck by which the same water makes its exit from the same vessel, in order that the water may be compelled to pass through every part of the interior of the vessel. The bottom of the stove is raised up from

the floor of the apartment in which the stove is placed by supports, in order to admit the external air beneath the bottom, that it may pass freely up into the spaces left vacant for its passage upwards between the several water vessels *c*, *d*, *e*. The top of the stove is a dome *a*, covering all the cylindrical vessels of which the stove is composed, and receiving all the air that rises up through the spaces *f*, *f*, *f*, *f*, between them. At the top of the dome *a* is a turning register of the same kind as is usually applied in other air stoves: that register serves to regulate the exit of the warm air from the stove, according to the quantity that is required to be discharged into the place where the stove is situated. *h* is a small tube joined at the highest part of the top branch *x*, *x*, which connects the three vessels *c*, *d*, *e*. The tube *h* passes up through the centre of the turning knob of the register at the top of the dome *a*, and has a small air-cock *m* at the top, which is open to allow the air to escape from the spaces *c*, *d*, *e*, when they are to be first filled with water, but when they become full the air-cock *m* is to be shut. To fill the apparatus for action, all the stop-cocks H, K, *t*, and *m* must be opened, and water being introduced into the upper vessel F, it will flow through the pipe G and cock H into the vessel C, and from thence by the pipes B, L, and N it will run down and fill the boiler A and the stove M until every part thereof is full. When the water begins to issue at the cock *m*, that cock must be closed, and also when the height of the water in the transparent or other vessel *s* indicates that the vessel C is full to the top, all the other cocks H, K, and *t* must be shut. Note.—This mode of filling the apparatus from the vessel F is that which may be commonly practised, though it is by no means essential that the water should be introduced at F. If convenience requires, the water may be introduced (either by a pump or by a pipe from an elevated reservoir) into any part of the apparatus, even into the boiler A, the only condition being that the whole apparatus shall be completely filled up to the level of the top of the vessel C. The fire is then to be lighted beneath the boiler A, and as the water within it becomes heated (and consequently becomes specifically lighter than the water in the other parts which has not been heated) the circulation will begin by the colder and heavier water in the descending pipe L, N, overbalancing the hotter and lighter water in the ascending pipe B, and therefore the colder water will force its way into the lower part of the boiler A, and displace and force therefrom a corresponding quantity of hot water up the ascending pipe B, and into the vessel C. It is obvious that a corresponding quantity of water will at the same time run down the descending pipe L, and pass through the stove M, where it will communicate part of its heat to the air that is contained in the spaces *f*, *f*, *f*, *f*, and the water thus becoming cooled (and consequently heavier) will descend through the descending pipe N into the bottom of the boiler, forcing

up a like quantity of heated water by the ascending pipe B, and so the circulation will go on. The fire under the boiler continues giving heat continually to the water that is within it, and the stove always communicates part of the heat of the contained water to the air that is passing through it, and which surrounds it. Hence the difference of specific gravity which causes the circulation is continually kept up so long as the fire is continued, and the apparatus kept at work. It it obvious that the heat given to the water should never be accumulated so much as to produce steam in the boiler. Note.—The ascending pipe B and the vessel C should be covered with wrappers of non-conducting substance, to avoid loss of heat by radiation and contact with the air, because the ascending column of water in A, B, C, must be kept hot, whilst that in L, M, N, is cooled. If more convenient, the ascending pipe B may be carried up within the chimney of the furnace for the boiler. The above apparatus is represented with only two of our stoves M, but the same boiler and pipes, and our safety reservoir (consisting of the vessel C, with the pipes and vessels marked D, E, F, G, H, I, K,) may supply several of our stoves, situated either in different places, or together in the same place, according to the distribution of heat and heated air that is required to be effected by the apparatus. It is advisable to place the stoves M on a level as much higher than the boiler A as convenience will allow, because the circulation will be the more rapid, and consequently the communicating of heat will be more effectual. The water which has passed through one of our stoves may afterwards be conducted through another stove, as is shewn by the Drawing, so as to serve both. The dimensions of the apparatus, and the form and disposition of the several pipes and vessels, must be adapted according to the situation in which the apparatus is to be fixed, and the space which is to be heated thereby. Few situations being alike in all respects, no rule can be laid down for dimensions, but the same must be left to the judgment of the artificer who is to construct the same, and he must adapt it according to local circumstances of each particular case. And as the materials of which the parts of the apparatus are to be composed, we prefer cast iron for the large pipes and reservoirs and for the stove, and wrought iron for the boiler. The smaller pipes and cocks may be of copper and brass; and although the vessels of which the stove is composed are stated to be cylindrical, they may be made square, or of any other form that is preferred for giving them an ornamental appearance.

In witness whereof, I, the said Charles Fox Price, have hereunto set my hand and seal, the Seventeenth day of February, in the year of our Lord One thousand eight hundred and thirty.

CHARLES FOX (L.S.) PRICE.

H. C. & C. F. Price's Improvements in Warming Buildings.

Wm Wingfield.

AND BE IT REMEMBERED, that on the same Seventeenth day of February, in the year above mentioned, the aforesaid Charles Fox Price came before our Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute in that case made and provided.

Inrolled the Twentieth day of February, in the year above written.

LONDON:
Printed by George Edward Eyre and William Spottiswoode,
Printers to the Queen's most Excellent Majesty. 1856.