F. X. Wurm,

Steam-Boiler Furnace,

No. 5,917, Patented Nov. 14, 1848.

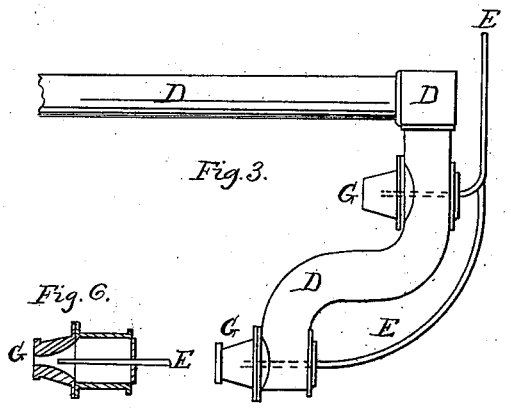


Fig. 3.

Fig. 6.

Fig. 4.

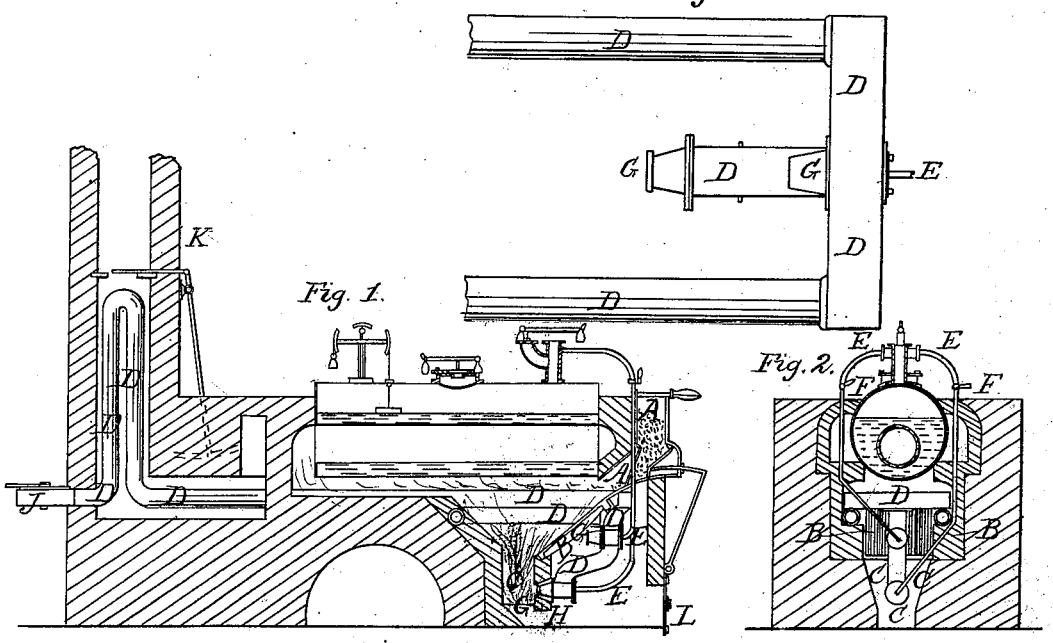
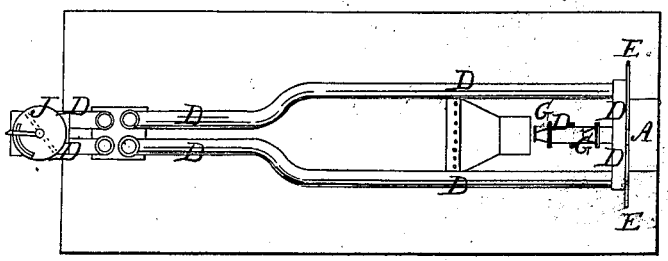


Fig. 1.

Fig. 2.

Fig. 5.



Inventor.
Francis X. Wurm

UNITED STATES PATENT OFFICE.

FRANCIS X. WURM, OF VIENNA, AUSTRIA.

FURNACE FOR STEAM-BOILERS, &c.

Specification of Letters Patent No. 5,917, dated November 14, 1848.

To all whom it may concern:

Be it known that I, FRANCIS X. WURM, of Vienna, in Austria, have invented a new and Improved Method of Constructing Furnaces, Including All Kinds where Fire is Used; and I do hereby declare that the following is a full and exact description.

My invention is founded on the following well known facts which I think necessary to be severally explained for the sake of the greater clearness of my specification: First that the developed quantity of caloric is the greater, the more perfectly and rapidly the combustion is proceeding; and the less, where such bodies as contribute nothing to the combustion, are participating in the heating. Second that flame has always a greater capacity of communicating heat than heated air, or other burning bodies; and that even flame, does not always and everywhere possess equal degrees of heat. Third that different kinds of fuel contain more or less incombustible materials such as slate or other earthy substances which in the proportion of their quantity, prevents or obstructs to a certain extent not only the process of combustion, but also the practical effects of the fire. Fourth that if warm air be conveyed to a burning body, a greater practical effect is obtained than by cold air, though the consumption of fuel is the same in both cases. Fifth that rarefied air conveyed through a heating apparatus receives more heat and more quickly than compressed air pushed or forced through the same apparatus. Sixth that the compressing of air in the heating-space, affords a higher temperature than is possible under the same circumstances by the rarefying aspiration of a chimney. Seventh the practical effect is obstructed by the conveying of too little as well as too much atmospheric air, because in the first case, a quantity of carbonic oxid escapes in a state of non-combustion, as soot and smoke, and in the second case the excess of air cools the fire and with the unconsumed oxygen etc. escapes a great part of the heat obtained. Eighth that the practical effect is the greater, when the process of combustion is nourished without any interruption or disturbance, and the compressed air is maintained at an equal height. Ninth that different qualities of fuel requires different arrangements of fire places, &c., in proportion as the developed heat is to surround larger or smaller surfaces, or is confined to a little space. Tenth that not all kinds of fuel afford an equally desirable practical effect, owing to their different capacities or qualities because, eleventh, those burning with a long flame are more convenient for heating brewer's boilers, steam-boilers, etc., than those with a short flame; but the latter ones produced more intense effects when employed for the use of forging, fusing or liquefying. Twelfth that the flammability of any fuel is the greater, the more hydrogen and oxygen is contained in it, and that the flame is shorter in proportion to the diminution of these ingredients in comparison with the quantity of carbon. Thirteenth that in inflammation of pit-coals, cokes and anthracite ("fossil coal") in convenient fire places is considerably augmented when connected with heated steam of water, and chiefly in the heating of steam-boilers a much greater practical effect may be obtained. Fourteenth that a current of steam having a tension of 3 or 4 atmospheres and let on in convenient proportion through a twyer iron and nose-pipe, is capable of driving about 4 or 6 fold volumes of air more than it is enabled to produce after rarefaction of air and before the condensation of air. Fifteenth that oxid of carbon, as well as hydrogen and carbureted hydrogen or hydrogen can be entirely inflamed only at those points where these gases are combined with a sufficient quantity of atmospherical air or oxygen. Sixteenth that fuel of any kind requires more or less atmospherical air for its combustion, in proportion as it contains more or less oxygen. Seventeenth that the accumulation of fuel on the grate, and the surface of the latter, depends on its construction, as the grate may be much smaller for wood and turf than for pit-coals, for wood and turf offer much large interstices to the passage of air, and therefore much less resistance, than pit-coals, etc., and they do not obstruct the grate, as is the case with the latter; the latter, therefore, want a grate of larger surface, and owing their much shorter flame, their distance from the surface of the boiler must never be greater than 12 or 14 inches; on the contrary, the grate for a turf-fire admits of a distance of 18 to 24 inches, and that for wood-fires even of 27 to 36 inches. Eighteenth that an attentive consideration of the different kinds of fuel

shows that carbon exists to a much greater extent in the fossil materials than in wood and is combined in such a way with the hydrogen and oxygen that it is completely consumed.

Wood fibers contain in 100 parts 52.65 carbon, 4.25 hydrogen, 40.10 oxygen; turf contain in 100 parts 60.44 carbon, 5.96 hydrogen, 33.60 oxygen; lignite contains in 100 parts 66.96 carbon, 5.27 hydrogen, 27.76 oxygen; pit-coal contains in 100 parts 76.18 carbon, 5.04 hydrogen, 18.67 oxygen; anthracite contains in 100 parts 92.85 carbon, 3.96 hydrogen, 3.19 oxygen; which materials, in the proportion of the oxygen and hydrogen; give a longer or shorter flame, so that the flame shortens in the same degree as the hydrogen and oxygen decreases, but in a narrower space of combustion its effect are more intense, and, lastly, nineteenth, that the practical effect obtained is considerably diminished in cases where a higher temperature is required even where the most complete combustion takes place. Twentieth, that practical results have irrefutably proved, that in the actual mode of heating, many of the most important natural means have remained unnoticed, and that a more convenient combination of these means may lead to a greater practical effect, so that in comparison with the actual mode of heating, the following results may be obtained:

	Wanted temperature.		*Practical effect.*	
By heating steam boiler.	80° Réaumur	instead of	50%	now 70%
	130° "	"	30 "	46 "
	150° "	"	22 "	34 "
By heating furnaces for making red hot, or puddling, fusing, forging, etc.	20° Wurm's pyrometer	"	18% "	28%
	30° "	"	13 "	21 "
	40° "	"	10 "	19 "
	50° "	"	8 "	16 "
	60° "	"	6 "	13 "
	70° "	"	5 "	12 "

The differences of the practical effect is to be explained by the necessity of immediately letting the heating fluid out of the firing room as soon as it has fallen below the required degree of heat.

In liquefying furnaces, where only the highest glow heat can be employed, every lower temperature must be let out, as disadvantageous, but in heating steam-boilers, the heating fluid can be advantageously employed up to a temperature of 130° Réaum., a lower temperature being wanted, the loss of heat must therefore be less considerable than where a higher temperature is wanted. In iron-works, foundries and furnaces for refining and smelting, they have recently made use of the escaping lower heat for warming the air of bellows, for roasting the mineral, for warming and annealing the pieces of iron, and in this manner obtained considerable savings of fuel; but the quantity of escaping heat is still so considerable that it is most desirable to employ it.

The practicable advantages of these experiments, and a suitable selection of mechanical means has led me to the happy results of a much more profitable heating principle, by which a great part of the combustibles are saved, as well as a more intense degree of heat obtained. The experiments mentioned in section 5, that rarefied air is able to absorb a much greater quantity of heat, and by its condensation, or (compression) producing a higher temperature, affords the means of increasing greatly the effects when needed of higher degrees of heat. Suppose a puddling, fusing or liquefying furnace wants in operation 50° of Wurm's pyrometer, it will be evident that a diminished temperature at only 45° W., for the mechanical operation as conducted already is not practical, and must be considered as lost for this purpose. But now, if with this fluid of rarefied air up to $2\frac{1}{2}$–3″, $\frac{8}{+}$, is heated only up to 25 to 30° W., and in the combustion space compressed just as much again, then will the heat in the combustion place be up to 55° W. and thereby with half the fuel, produce in the fire place a much greater effect than has till now, by my invention, been possible to obtain with double the quantity of fuel.

By the facts stated in sections 12, 13, 14, 15, 16 and 17, it is shown that a much livelier and greater length of flame is obtained, as well as more intense effects produced by the compression of the air in the combustion space, than before was possible, and also to cause its more perfect rarefication in the heating pipes.

To represent more clearly the invention of my new heating principle, I will refer to the annexed drawings. I declare my invention to consist in the following combination and arrangement of mechanical principles: First that the air intended for nourishing the fire is sucked or drawn through a system of pipes, applied in the furnace, and chimney or smoke hole, and in which it is rarefied or heated. Second that this air when heated or rarefied is forced through a twyer iron of the bellows pipe, or through other sucking or bellows apparatus into the heating space, and to the place of combustion at an increased temperature. Third, be condensed in a combined grate and pit and heated to an increased temperature to cause the kindling of the fire under a fixed pressure. Fourth, be producing by the decomposition of the jet of steam a livelier, prolonged, and more intense inflammation; and fifth, maintaining the heating fluid in the whole space of the volume of flame, up to the outlet of the chimney, at an even pressure, and therefore also at as great a temperature as is required. From these mechanical combinations it is evident that this heating principle has these substantial differences from all other contrivances now in use: That the air during its heating and

rarefication is compressed while being forced into the space of combustion, when it comes forth with an increase of temperature, which until now was only rarefied in the fire place, through the draft of the chimney; or as in locomotives, through the starting power of the escaping steam when in motion, and thereby reducing the intensity of the heat.

Description of the annexed drawings.

A, the opening for putting in the fuel and kindling the fire. B, the inclined fire grate. C, the combustion or burning pit into which the fuel gradually falls down of itself. D, the air pipes, in which the air is heated or rarefied. E, the steam conducting pipes of wrought iron, which are opening into the blowing pipes or twyer irons. F, the steam cocks for regulating the blowing. G, the twyer irons or nose pipes of the blowing tube of wrought iron, through the center of which is conducted the current of steam, and by means of which the air is rarefied afterward, as much as it was compressed before, when it is expelled in a more heated state into the fire. H, the opening of the ash pit, closed only by the unconsumed cinders. I, the regulator valve by which the air is drawn into the heating pipes and its rarefication regulated. K, the cut-off valve in the mouth of the chimney, through which the pressure of air in the fire place is regulated. L, is the air tight door of the ash pit, through which from time to time the ashes are taken out.

As at kindling the fire at first, the requisite draft of air cannot be obtained through the power of steam, it is necessary to open the ash pit door L, as also the stopping valves I and K, when the requisite draft will be obtained as in the usual way, after which they may be closed and the steam used as before stated to produce the draft.

From this description, with the annexed drawings the practical mechanic will readily understand the combination and operation of my new heating principle and be able to construct and apply the same to boilers and furnaces of every description. And to prevent infringement of my invention, I will here state that my new heating principle, or apparatus, may be made in several ways, by modifying the above combination, but so long as the principle or substantial parts of my invention are the same as such modifications, I shall consider the use of the invention as an infringement of my rights.

I do not claim the introduction of steam into furnaces, nor of heated air, nor merely applying steam and heated air together for the purpose of promoting combustion of coal or other fuel—but

I do claim—

1. The manner herein set forth of employing steam and heated air together; the same consisting substantially of the combination of the steam pipes E, E, twyers G, G, and close chamber or ash pit.

2. And I also claim the employment of the two sets of twyers for introducing steam and heated air in the manner described, that is to say, one being applied at the grate bars, while the other is applied to the combustion pit for the purposes substantially as herein set forth.

FRANCIS XAV. WURM.

Witnesses:
FRIED. GREGER,
JAS. RADNITZKY.