(No Model.)

E. CLIFTON.

APPARATUS FOR HEATING WIRE.

No. 343,010. Patented June 1, 1886.

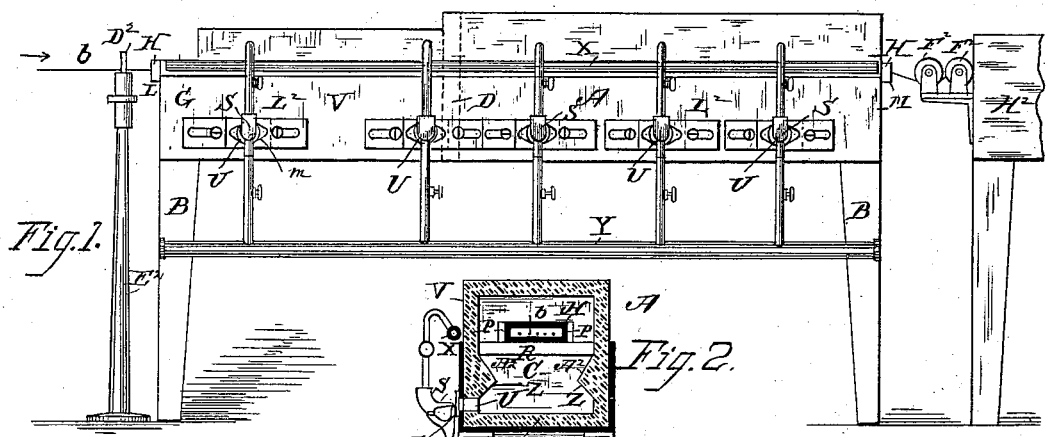

Fig. 1.

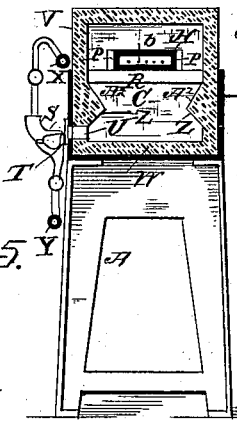

Fig. 2.

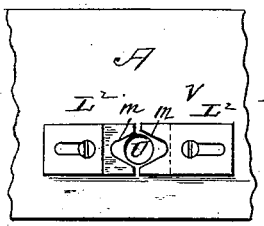

Fig. 5.

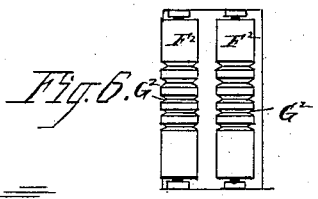

Fig. 6.

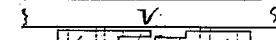

Fig. 7.

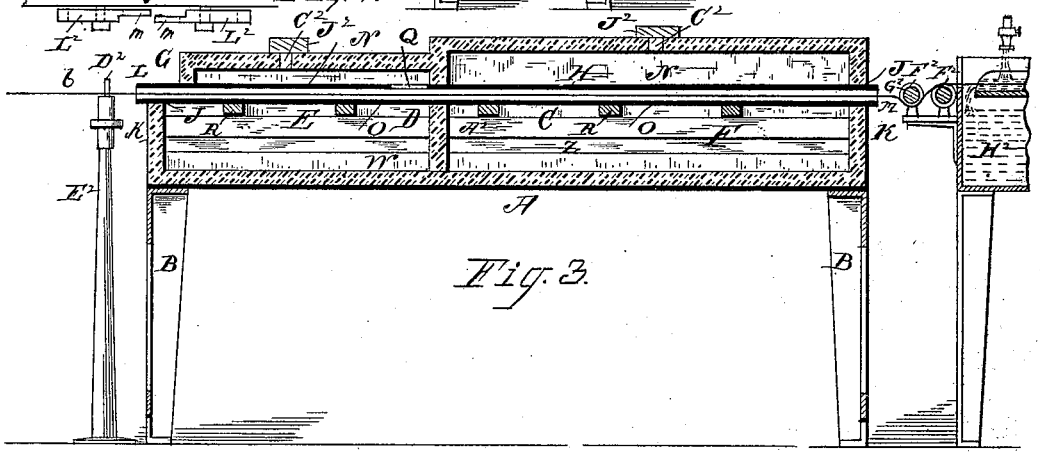

Fig. 3.

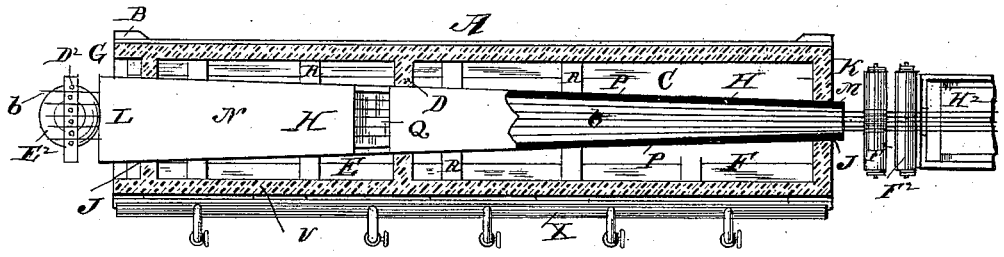

Fig. 4.

Witnesses
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Inventor
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Attorneys

UNITED STATES PATENT OFFICE.

EDWARD CLIFTON, OF LOWELL, MASSACHUSETTS.

APPARATUS FOR HEATING WIRE.

SPECIFICATION forming part of Letters Patent No. 343,010, dated June 1, 1886.

Application filed May 11, 1885. Serial No. 165,118. (No model.)

To all whom it may concern:

Be it known that I, EDWARD CLIFTON, of Lowell, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for Heating Wire, &c., of which the following is a full, clear, and exact description.

The invention is particularly designed for the heating of steel wire in the process of hardening and tempering the same.

The method to which the apparatus of this invention is particularly applicable consists in subjecting the wire to be heated for the purpose of being hardened to the action of heat in a furnace of suitable construction therefor, and which is adapted with openings for the wire to be entered into and passed through and out of it, and preferably under a regular and continuous movement, and at the same time inducing and producing in said furnace and from the combustion taking place therein a pressure sufficiently great to prevent the entrance of air into the furnace and at its said openings for the entrance and escape of the wire, and thus the oxidization of the wire as it is so heated.

The apparatus of this invention in substance consists of a furnace which has a combustion and heating chamber preferably adapted for the combustion of hydrocarbon and steam, and for their entrance therein in the form of a spray at intermediate points from end to end along and for the whole of its length, and provided at its opposite ends with openings, the opening at one end for the continuous entrance, and the opening at the other end for the continuous discharge, of the wire continuously passing, suitably supported, through the furnace, but otherwise closed on all sides and at all points, all substantially as hereinafter described, and whereby in the operation of the furnace to heat the wire as desired combustion and heat is secured and maintained in the furnace, and at a pressure sufficiently great to resist and prevent the entrance of air at the receiving and discharging openings of the furnace, which, as well known, if it were allowed to enter, would and does act to oxidize the wire under heat in and passing through the furnace.

In addition to the above the invention consists in other improvements in the details and appurtenances of the furnace, all substantially as hereinafter described.

In the accompanying drawings, forming a part of this specification, the apparatus of this invention is illustrated.

Figure 1 is a side elevation of my improved hardening-furnace. Fig. 2 is a transverse vertical section, line 2 2, Fig. 1. Fig. 3 is a central longitudinal vertical section, line 3 3, Fig. 2. Fig. 4 is a horizontal section, line 4 4, Fig. 3. Figs. 5, 6, and 7 are enlarged views in detail, hereinafter referred to.

In the drawings, A represents a furnace (shown as made of a rectangular box shape) closed on all sides and preferably lined with fire-clay or other suitable non-combustible material, and also preferably one which is a non-conductor of heat. The furnace A is horizontal, and it is supported at its four corners on legs B. C is the combustion-chamber. This chamber C, as shown, is divided transversely and intermediate of its length by a closed partition or wall, D, preferably of fire-clay or other non-combustible material, into two separate and distinct compartments, E and F, of unequal length preferably, and the shorter compartment, E, is at the front end, G, of the furnace—that is, the end at which the wires are entered into the furnace.

H is a horizontal trough extending from end to end of the divided combustion-chamber C of the furnace, through the partition-wall D, and communicating at each end with an opening, J, in each end wall, K, of the furnace. This trough H, within the furnace, is wholly surrounded by the combustion-chamber C, and it tapers in width from the front end, G, to the rear end, and, as shown, within the combustion-chamber it is closed on all its sides, upper and lower, N, O, and vertical, P, except in the forward compartment, E, and near the partition-wall D it has an opening, Q, on its upper side, making communication between its inside passage and the combustion-chamber. The trough H is made of cast-iron or other suitable material, cast-iron being suitable, and R are cross-bars supporting it in the combustion-chamber, as described, and located at intermediate points. These cross-bars are made of fire-clay or other suitable material.

S and T are a series of jets arranged in pairs

at and along one side and the length of the furnace. The jets of each pair are at right angles to each other and opposite to and just outside of an opening, U, of one side wall, V, and at or near the floor W of the combustion-chamber. The jet S, the upper and horizontal one of each pair of jets, is for steam, and the jet T, the lower and vertical one, is for hydrocarbons, and the several steam-jets are connected to a common steam-supply pipe, X, and the several hydrocarbon jets are connected to a common hydrocarbon-supply pipe, Y, and as well known and heretofore practiced in furnaces for heating wire, all so as to secure the commingling of steam and hydrocarbon and the introduction thereof in a spray form through the openings U of the side wall, V, of the furnace into the combustion-chamber thereof, to be therein consumed for the purpose desired.

In the division of the combustion-chamber, and as the combination therewith of hydrocarbon and steam jets described is shown, the shorter or forward compartment, E, of the combustion-chamber C is provided with two sets or pairs of hydrocarbon and steam jets, and the longer or rear compartment, F, with three sets or pairs of such jets, and one set or pair of such jets of the forward compartment is located in close proximity to the partitioning-wall D of the combustion-chamber. The part of the combustion-chamber which is below the trough and directly above the horizontal plane at which the gas and steam-jets enter the combustion-chamber through the opening in the side wall thereof has its opposite side walls made inwardly converging at Z toward the center, but for only a short portion of the width of the furnace, and thence they are returned with an upward inclination, A^2, finally meeting the direct vertical face of the wall at or near the lower side or edge of the cross-supports R for the trough H.

C^2 are openings in the upper wall of the furnace, one in each compartment of the combustion-chamber; and J^2 are attachable and detachable covers closing said openings.

In the operation of the furnace the openings C^2 are closed by the covers J^2, and the covers are only to be removed, if at all, when combustion is first started and at such other times as it may be thought desirable to observe or note the condition of the heat in the furnace.

The top openings, C^2, of the furnace are not chimneys or flues in any sense, nor are they so intended. They may be dispensed with, for they have no practical effect in the operation of the furnace in accordance with this invention, as will hereinafter appear. The openings C^2 are, however, convenient and useful for the purpose stated.

The furnace at the outside of the front end is provided with suitable vertical guide-pins, D^2, of a standard or frame, E^2, for guiding and keeping the several lengths of wire separate as they pass into the furnace from their respective coils or reels, and at the rear end and outside the furnace is provided with a pair of horizontal guide-rollers, F^2, placed in advance the one of the other and turning in suitable supports. Each roller F^2 has a series of peripheral grooves, G^2, to receive the separate wires, *b*, passing from the furnace, and which pass a wire to each groove under the first and over the second roller, considering the rollers in relation to the direction of travel of the wires through and out of the furnace, and from the second roller to and through the bath H^2 of oil, to pass from that to the tempering-oven to be tempered. Passing the wires under the first and over the second of the rollers F^2 secures a tension on the wires as they pass through the furnace, and the grooves of the rollers are placed closer together than are the guide-pins D^2, at the front end of the furnace, for the purpose of causing the wires, as they travel through the furnace, to be gradually moved toward each other and closer together, but without being brought into contact with each other as they issue from the rear or discharging end of the furnace; and the taper (before referred to) of the trough substantially corresponds thereto. (See Fig. 4.)

The furnace herein described, in use, is heated by the combustion of the hydrocarbon and steam, which are entered at the holes U in the side wall, V, thereof, and when this combustion is first started it is preferably with the openings C^2 in the top of each compartment of the combustion-chamber opened, but after combustion is obtained said openings C^2 are closed by a suitable cover, J^2, placed over them, and thereafter they so remain closed, so that then, practically, the combustion of the furnace is wholly confined within the compartments of the combustion-chamber proper, thus inducing and producing within each compartment of said combustion-chamber a defined practical and substantial pressure of the gases, vapors, and heat resulting from such combustion, and to a degree, in either or both, sufficient to secure therefrom—that is, in the forward compartment of the combustion chamber, which is the only compartment open to the trough—an action or pressure in both directions along the length and within the whole cubic capacity of said trough of a force and power sufficient to prevent the entrance of air at either open end of said trough to the wires passing through the trough, and being heated by the action of the furnace, which, if it were not so, or otherwise suitably prevented, would, as is well known, cause an injurious oxidation of the wires, susceptible as they then are thereto, owing to the high degree to which they are heated, for the purpose of a proper and suitable hardening thereof.

The trough, herein particularly described, and shown in the drawings, it is plain, makes a support for the length of wires passing through the furnace and from end to end thereof, and while a trough substantially as described, as practical experience and use have demonstrated, is most efficient for securing the result aimed

at by this invention, yet a shelf having an opening between each of its side edges and the opposite side walls for the whole and along the length of the furnace, or a perforated shelf or even simple cross-bars may be substituted for it, and with good results, in the direction aimed at by this invention; and so it is not intended to limit the invention in that regard.

The partition D, dividing the combustion-chamber into compartments, as has been described, may be dispensed with and yet secure to the action of the furnace described; but, however, while the changes above indicated may be made and the operation of the furnace not affected in principle, it is plain it will be affected in degree, and thus a furnace can be adapted to a variety of work—as, for instance, wires of large and small diameter.

The construction of furnace herein shown and particularly described, and has been before stated, has been found most efficient and practical with wires of small diameter, and while the portion of the trough in the rear compartment of the combustion-chamber is shown as closed along and on the upper side, yet it may be more or less left open; but it is preferable in that case, as in most all cases, to have the upper side of this portion of the trough always closed, for the reason that the wires in such portion of the trough are at their greatest heat, and therefore consequently the most susceptible of oxidation should air come in contact with them; and by having this portion of the trough so closed, with the forward portion open, as has been described, obviously the greater is the outward draft or pressure through the same toward the delivering end of the trough, to prevent the entrance of air thereat to the wires under heat in the furnace. Again, the partition dividing the combustion-chamber into compartments, as described, combined with the location of a set or pair of jets, S T, and of the openings Q, into the trough H, near said partition, places, as it were, the draft or pressure through the trough outwardly in opposite directions within the control of the attendant, who, by increasing the supply of hydrocarbon to the furnace at such jets to a point beyond the power of the furnace to consume it, can at any time demonstrate the action of the furnace, or, in other words, the pressure through the trough above described, and thus secure its proper regulation.

Hydrocarbon and steam jets herein described of themselves, separately or in combination, constitute no part of the present invention, for the same are well known in other furnaces, and the same have been herein described, as they are most effective means for the operations described.

The inward converging of the side walls of the furnace above described concentrates the combustion and heat thereof within the central part of the furnace, and directs it about and against the under side of the trough, from which it spreads out and around the sides and over the top and into the upper part of the chamber, where combustion is complete and perfect.

The guide-pins D^2 and the separate grooves G^2 of the grooved rollers F^2 F^2, while guiding the wires in their travel through the furnace, also secure a gradual drawing of them toward each other and as they issue from the furnace, but without contact. By this means the wires are made the better to retain their heat as they pass from the furnace to the oil bath, and in this relation the taper of the trough H renders efficient service by concentrating or confining the heat of the furnace the more closely to the gradual closing-up wires.

Each opening U in the side wall of the furnace for the entrance of the hydrocarbon and steam, as described, is provided (Figs. 5 and 7) with a horizontal slide, L^2, on its opposite vertical sides, and each slide is notched at its end *m* which is toward the same end of the other slide, and they are adapted at such notched ends to slide the one by the other and across the side opening. By means of these slides said openings U can be reduced in area, as may be desired.

Although this invention has been described and shown particularly in relation to wire, it is, as is plain, adapted to other articles, and so is not to be limited in that regard.

Practical and daily use of an apparatus substantially as described in the hardening and tempering of wire has shown most satisfactory results, and the absolute absence of any oxidation of the wire hardened and tempered.

Having thus described my invention, I claim—

1. A furnace for the heating of wire, having a combustion-chamber provided at either end with an opening for the passage of the wire, but otherwise practically closed, adapted for the combustion of hydrocarbon and steam, and divided into transverse compartments having no communication with each other, and each provided with a support for the wire, the support in the compartment at the discharging end of the furnace consisting of a tube closed thereto, but open to the other compartment and for the discharge of the wire therefrom, substantially as described, for the purposes specified.

2. A furnace for the heating of wire, having a combustion-chamber provided at either end, with an opening for the passage of the wire, but otherwise practically closed on all sides, adapted for the entrance and combustion of hydrocarbon and steam therein, and having interior converging walls, in combination with a support for the wires within said combustion-chamber, substantially as described, for the purpose specified.

3. A furnace, A, having combustion-chamber which is closed on all sides, and side apertures, U, and hydrocarbon and steam jets located thereat, in combination with a trough, H, extending through the combustion-chamber from end to end and communicating at

either end to the outside of the furnace and on its upper side to said combustion-chamber, substantially as described, for the purposes specified.

4. A furnace for heating wire and the like preparatory to hardening and tempering it, provided with a series of hydrocarbon and steam jets arranged in pairs and for the entrance of their respective discharges into the furnace through apertures U in the walls thereof, to be therein consumed, and otherwise adapted for the entrance of wire and the like into and its discharge from, and having a support within, the furnace, and slides or dampers L^2 for the apertures U, substantially as described, for the purposes specified.

5. The combination, with a furnace suitable for heating wire and the like in continuous moving and separate lengths preparatory to hardening and tempering the same, the trough H, extending from end to end of the furnace, open on its upper side and tapering from end to end, substantially as described, for the purposes specified.

6. The combination, with a furnace suitable for heating wire in continuous and moving and separate lengths preparatory to hardening and tempering the same, of a guiding and feeding mechanism for the separate lengths of wire, which consists in substance of a row of guide-pins, D^2, at one and the front end of and across, and of grooved rollers F^2 at the other and back end of and across, the furnace, and having the rollers horizontal and their grooves situated nearer to each other than said guides, substantially as described, for the purpose specified.

7. The combination, with a furnace suitable for heating wire in continuous moving and separate lengths preparatory to hardening and tempering the same, and having along its length at and back of its discharging end a trough closed or tube tapering toward said discharging end and suitable for the passage of said separate lengths of wire through it from end to end, of a guiding and feeding mechanism for the separate lengths of wire, which consists in substance of a row of guide-pins, D^2, or other suitable guides at one and the front end of and across, and of grooved rollers F^2 at the other and back end and across, the furnace, and having the rollers horizontal and their grooves situated nearer to each other than said guides, substantially as described, for the purpose specified.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

EDWARD CLIFTON.

Witnesses:
WM. S. BELLOWS,
ALBERT W. BROWN.