W. R. Johnson.

Thermotension of Iron.

No. 826. Patented Jul. 9, 1838.

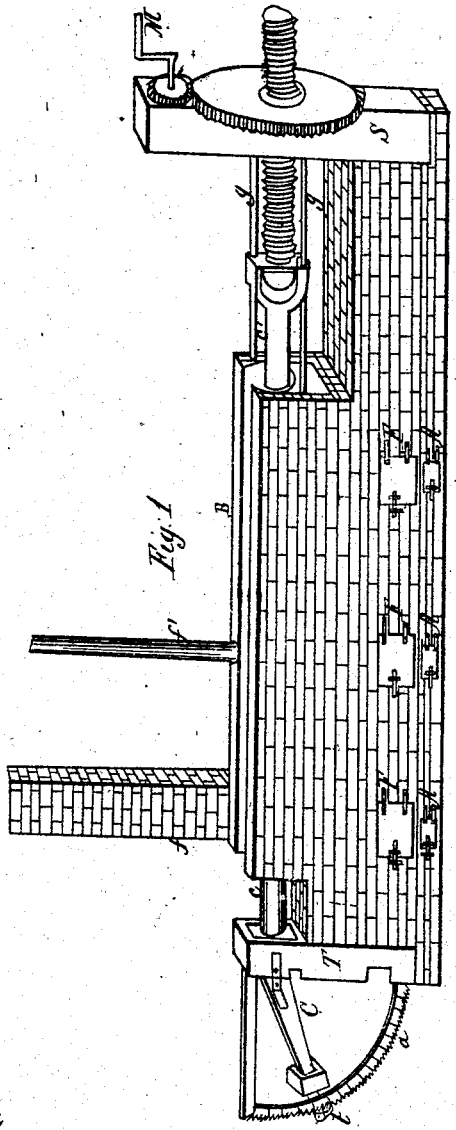

Fig. 1

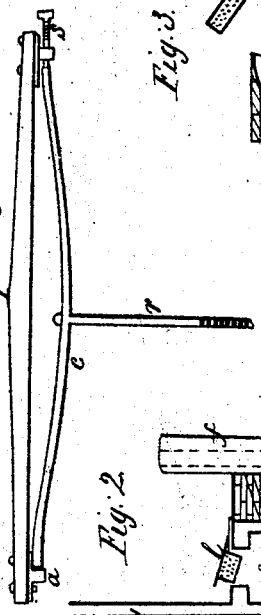

Fig. 4

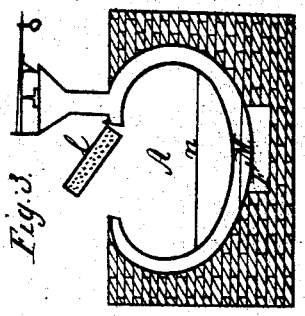

Fig. 3.

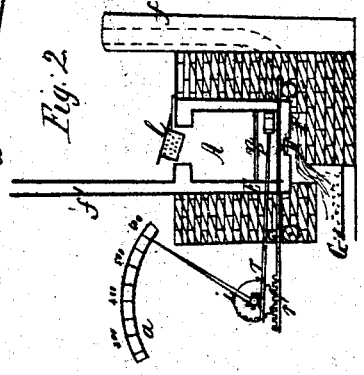

Fig. 2

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UNITED STATES PATENT OFFICE.

WALTER R. JOHNSON, OF PHILADELPHIA, PENNSYLVANIA.

IMPROVEMENT IN THE ART OF INCREASING THE STRENGTH OF WROUGHT-IRON AND STEEL.

Specification forming part of Letters Patent No. **826**, dated July 9, 1838.

To all whom it may concern:

Be it known that I, WALTER R. JOHNSON, of the city of Philadelphia, in the State of Pennsylvania, have invented a new and useful Improvement in the Art of Increasing the Strength of Wrought-Iron and Steel and of articles formed of said materials; and I do hereby declare that the following is a full and exact description of the machinery for carrying into effect the said improvement.

I construct a double trough or box of metal or other convenient material capable of sustaining the action of fire, which trough I place over a flue or hot-air conductor supplied with hot air, gas, or smoke from stoves, fire-places, or furnaces situated at a convenient distance below it. Between the two parts of the said double trough or box there is included through the whole length of the same a space or cavity for containing and conducting the hot air, gas, or vapor which I admit into it through holes or valves in the outer shell or box over the hot-air flue already described. This cavity I call the "heating-box." The form of the cross-section of the heating-box will depend on that of the two troughs which compose it, and will be either rectangular, elliptical, or formed of two arcs of circles greater than semicircles, or in any other form which may be most convenient for the kind of work to be done. The proportions of the length, breadth, and height of the box must in like manner depend on the form and the quantity of the materials which it may be found necessary to place within it at any one time.

The two troughs constituting the heating-box may be united by riveting or formed together by casting. There is an opening on the top of the inner trough through its whole length, by which the materials to be operated upon are introduced; but a cover or covers of iron or other materials may be adapted to fit it in such manner as to prevent the escape of heat from within. Said covers may be formed either of simple sheets of metal shaped in the proper manner, or they may be metallic boxes filled with charcoal, dust, or other non-conductors of heat. The aforesaid box or trough is to be set in brick-work or other substantial fire-proof materials and surrounded by non-conducting substances, except the top, ends, and such other parts as may be exposed for the purpose of bringing out the pyrometric rods, hereinafter described.

In the bottom of the outer shell or trough, or at the ends in the space between the two, are a number of holes for admitting hot air, gas, vapor, flame, or smoke into the heating-box, and from the top of said box, either at the ends or at any convenient intermediate points, are flues or tubes for carrying off the hot air or gas after it has traversed the heating-box.

In order to measure the temperature of the inner trough and of its contents, I employ any form of thermometer or pyrometer, or the expansion or fusion of any solid substances or the evaporation of any liquid which may be found best adapted to each particular form and size of apparatus. Bars of metal, either simple or compound, and traversing the heating-box either longitudinally, transversely, or in spirals, may by their expansion be made to act on a lever or levers, wheel or wheels, and give motion to indexes moving over graduated, straight, or curved lines.

For heating apparatus on a large scale I employ the following construction of apparatus to serve as a pyrometer: On the inside of the inner trough, near the bottom, are two projections of metal at a convenient distance apart, between which are to be placed the two ends of a bar of brass, so long as to require to be bent or curved slightly in order to be made to enter between the said projections, in one of which is a screw to regulate the curvature of the bar by increasing or diminishing the pressure on its two ends. From the middle of the said bar of brass there proceeds a rod, passing out through the side of the double trough by slots perforated for that purpose, and the said rod gives motion to levers or wheel-work for moving indexes, as before stated.

Instead of connecting the brass bar to the side of the heating-box, I shall sometimes attach it in a manner similar to that above described to a stiff bar or rod of cast-iron, plumbago, glass, or other substance of a low rate of expansion by heat, and shall, when necessary, use two bars of brass on opposite sides of the same bar of the other material, so that they may form a bow each way from the central

line or bar. In the latter case the instrument will bear a near resemblance to Regnier's pyrometer, and the rod will pass from one brass bar to the other to move the index situated on the latter, traversing in its course the intermediate bar of the material of low expansion.

When the expansion of solids is employed for indicating the temperature of the heating apparatus, I make use of the same to close the holes in the outer box already mentioned and to open a register from the flue beneath the heating-box into an escape-pipe connected with the same, thereby allowing the heated air to pass off without coming in contact with the inner trough.

When I mark and regulate the temperature of my heating apparatus by the expansion of bars and the motion of indexes and valves, as already described, I graduate the scales over which said indexes are to pass by ascertaining the points at which they stand at two or more given temperatures in the following manner: After establishing the heating-box and pyrometer firmly in their places, I surround the pyrometer with snow or pounded ice, which is allowed to remain until the whole apparatus has acquired a temperature of 32° Fahrenheit, which is marked at the point where the index then stands. Heat is then applied by lighting fires in the stoves or furnaces, the ice is melted and made to boil briskly, surrounding the pyrometer with either boiling water or steam, and when the index becomes stationary I mark the point 212°. The water is next removed, and around the pyrometer-bars are wrapped leaves, strips, or masses of pure tin, after which the heat is very carfully raised until the same shall be perceived to be melting and falling off, the point at which the index then stands is marked 442°. A number of thin glass flasks of mercury are then disposed along contiguous to the pyrometer-bars, and when they begin to boil the scale is marked 652° at the point denoted by the index. When I would mark higher temperatures than that of boiling mercury I ascertain them by placing on or near the pyrometer-bar an iron vessel to hold melted tin, into which is plunged the standard piece of a steam-pyrometer. The apparatus is then heated to any required extent, and, noting the position of the index, I withdraw the standard-piece and immediately plunge it into the boiling water of the pyrometer to which it belongs, to ascertain in the usual manner the number of degrees which must be set upon the point which was given by the index on taking the standard-piece out of the tin.

Another mode in which I regulate the temperature of the heating-box is by making it air-tight; but, instead of using it as a passage for hot air, placing within it a quantity of mercury or other liquid having a high boiling-point sufficient to occupy all that part of the lower or outer trough which is exposed to the flue below it. The inner trough and the pieces of metal under process will then be heated by the vapor of the liquid surrounding them. In this case, instead of flues in the upper part of the box to carry off the air, as above described, are placed funnel-shaped receptacles for the vapor of mercury or other liquid, in which it may be condensed and flow back again into the heating-box. A safety-valve of the common form will be placed in this receptacle to secure the box from injury by explosion.

When I apply the heating-box to the purpose of heating pieces of great length, instead of establishing it in fixed and solid masonry, I place it on a car, together with its furnace and appendages, and the said car is then set on rails beneath the piece of metal to be acted on and caused to move at a convenient speed from one end to the other of the iron, communicating in succession the same temperature to every part of the piece. This method is particularly applicable to the wire cables used for sustaining suspension-bridges. To know when each part of the metal has arrived at the proper temperature, sheets of metal or of some alloy which melts at a temperature below 600° Fahrenheit are disposed at short distances along its whole length, and the velocity of the car is regulated by the readiness with which they are melted off.

Instead of the kind of heating apparatus and machinery herein employed for increasing the strength of iron by the process of thermotension, I shall, when iron is manufactured by rolling, whether into bars or sheets, perform that process by drawing it for the last time forcibly through the rolls while the temperature is not above 600° Fahrenheit. In like manner, in manufacturing wire I place a heating apparatus in such a position that the wire, after passing the draw-plate, shall be heated to 550° Fahrenheit before it is wound up by the spool or reel. Another improvement which I have made on the art or process of increasing the strength of iron and steel by the process of hot-straining, is, that instead of the usual forms of dynamometer or apparatus to measure the force applied to the metal, I make use of a straight beam or lever, one end of which is loaded with any convenient constant weight, and near the other end is a gudgeon to take hold of two straps, which are placed one on each side of the beam. These straps are extended to any convenient distance beyond the beam, and terminate in or are connected with the hook or other holding apparatus for connecting the pieces of iron to the dynamometer. Between the said gudgeon and the weight, at the opposite end of the lever, is placed the fulcrum which is to be applied to the solid support of the dynamometer; but, instead of consisting of a simple gudgeon, I form this fulcrum of a solid casting or other strong piece of metal bent twice at right angles, and having the lever traversing its middle section between the two projecting arms of the bent portion, each of which being then reduced to a proper bearing

edge, they constitute together the principal fulcrum. The opening between the two parts of this fulcrum is intended to give room for the straps already described and to allow the fulcrum distance to be diminished at pleasure. The weighted end of the beam plays between two quadrantal arcs of a circle, each of which is cut into a ratchet and has on the side of the lever a click to correspond, which will support the lever at any elevation less than the whole length of the arc.

In using this dynamometer the ratchet-arc serves as a register for the strength of the metal, being made to hold the lever at the elevation to which it would be raised by such a strain as would break the piece under trial at ordinary temperatures. Any addition to the force will raise the loaded end of the beam. The graduated ratchet-arc is marked with the number of tons or other weights which the dynamometer measures, on the principle that the force applied on the shorter arm of the beam in a horizontal direction will, if the beam be supposed to be, when unloaded, self-balanced on its principal fulcrum, be directly proportional to the weight placed on the longer arm multiplied by the length of that arm and again multiplied by the sine of the angle measured on the arc, reckoning from the lowest point of it, and inversely proportional to the length of the shorter arm multiplied by the cosine of the same angle measured in the manner just stated.

The above-described heating-box is, when used, to be placed so that a mechanical power for straining the metal may be at or opposite to one end of the said box and the dynamometer above described at the other end, with proper holding machinery to connect each with the pieces of the metal which are to undergo thermo-tension.

What I claim as new in this invention is—

1. The above-described double trough, forming a heating-box, with its apertures, valves, registers, flues, receptacles for condensed vapor, and its other appendages, as the same are applicable to the purpose of increasing the strength of iron and steel in the process of straining the same at a high temperature.

2. The increasing of the strength of bars, rods, or plates of iron by drawing them while hot through the rolls by mechanical power of any suitable kind.

3. The increasing of the strength of wire by heating the same after passing through the draw-plate, as described above.

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Witnesses:
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THOS. FLETCHER.