

No. 854,005.

PATENTED MAY 21, 1907.

L. W. STANLEY.

MEANS OR APPARATUS FOR BURNING OR FIXING THE COLORS UPON
PRINTED OR DECORATED TILES, GLASS, &c.

APPLICATION FILED DEC. 15, 1905.

Fig. 3.

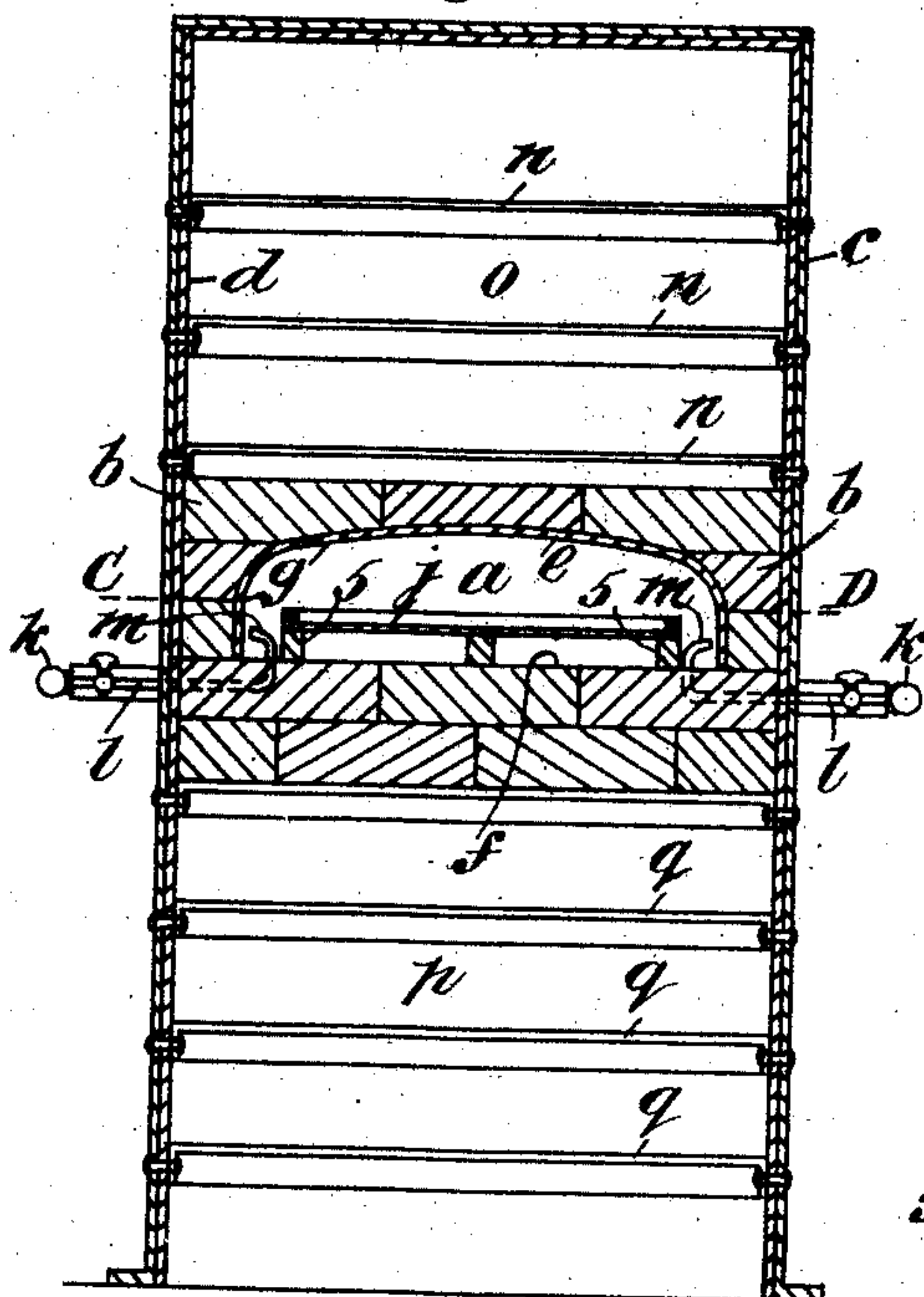


Fig. 2.

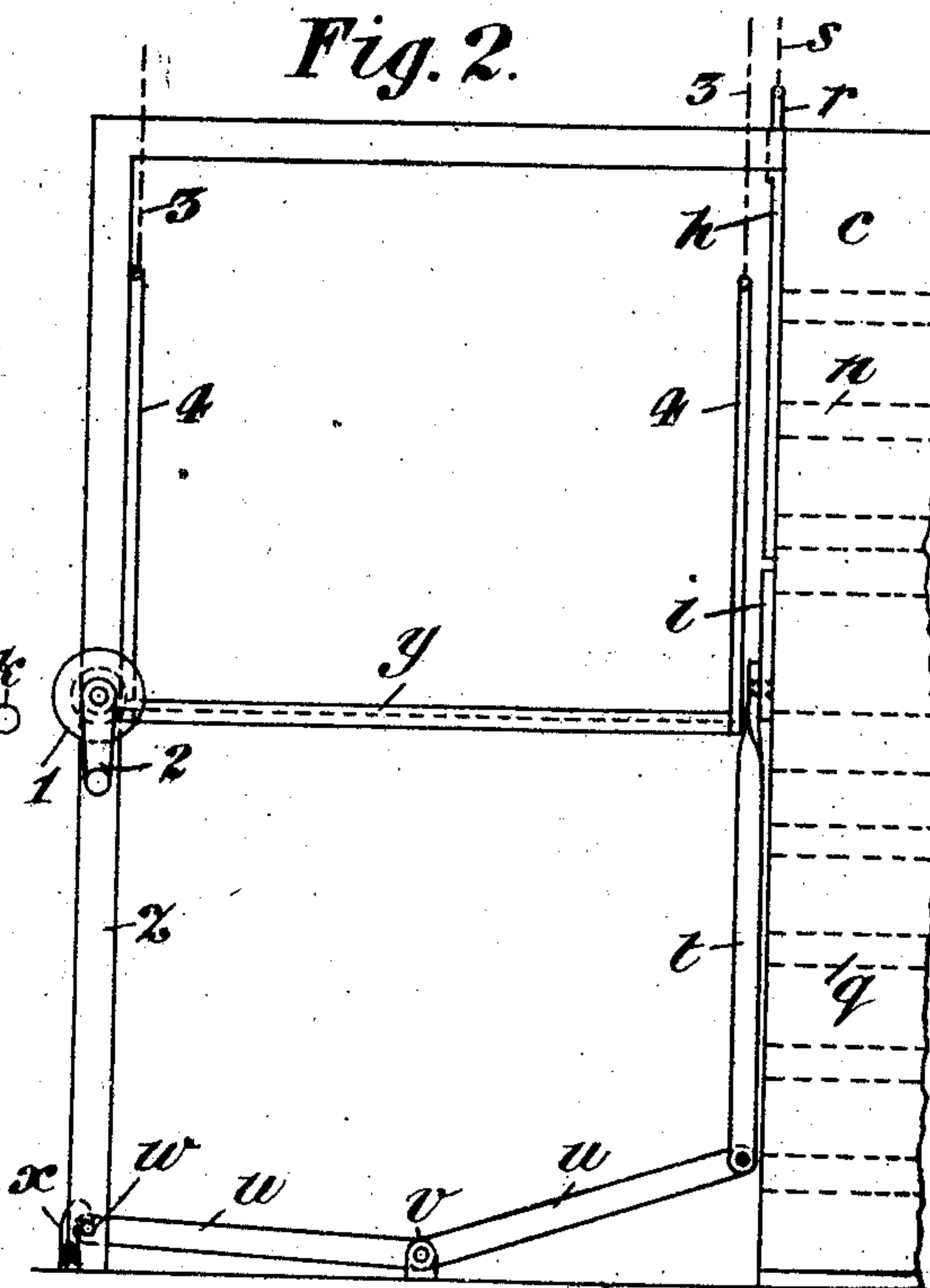


Fig. 4.

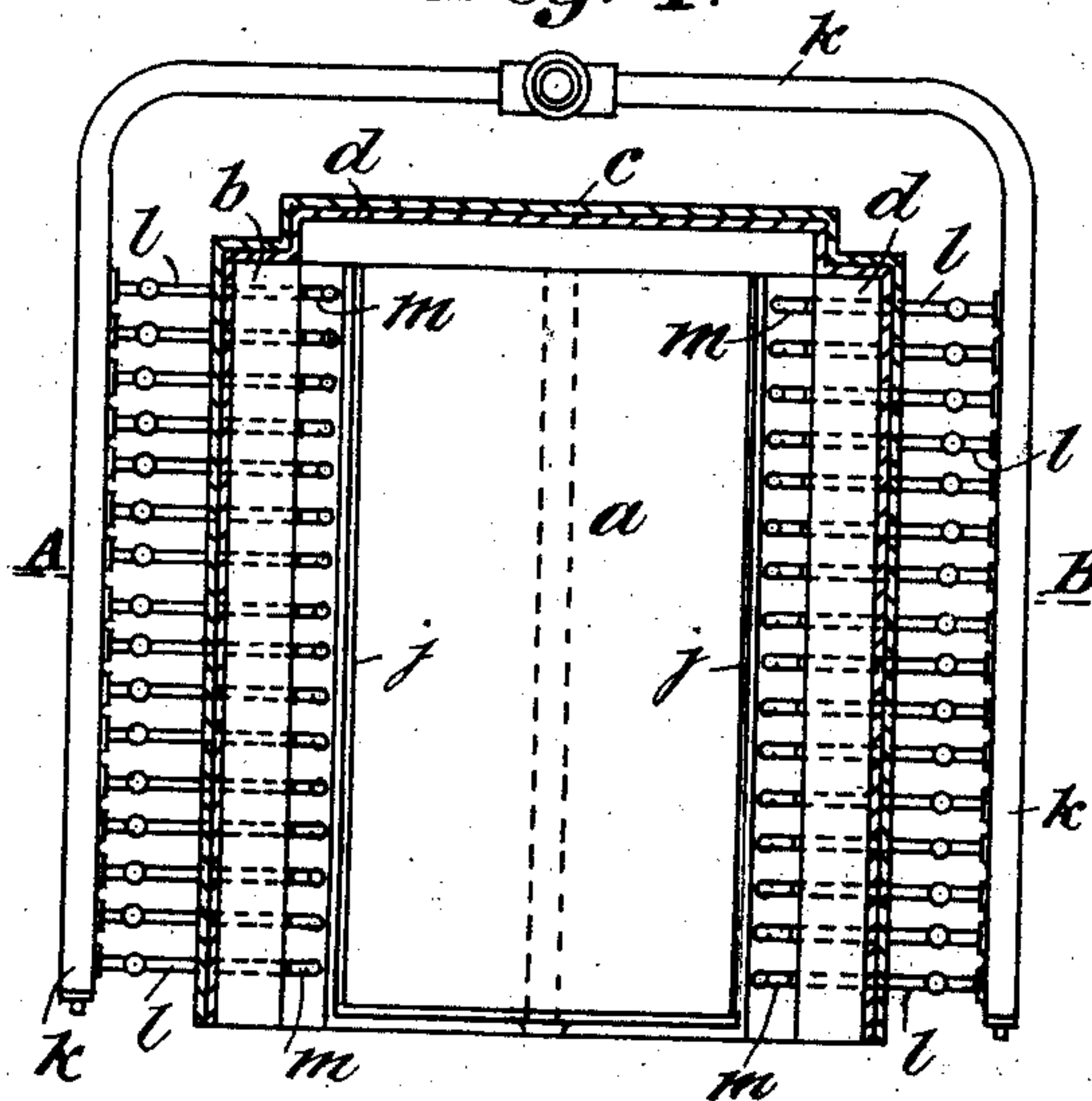
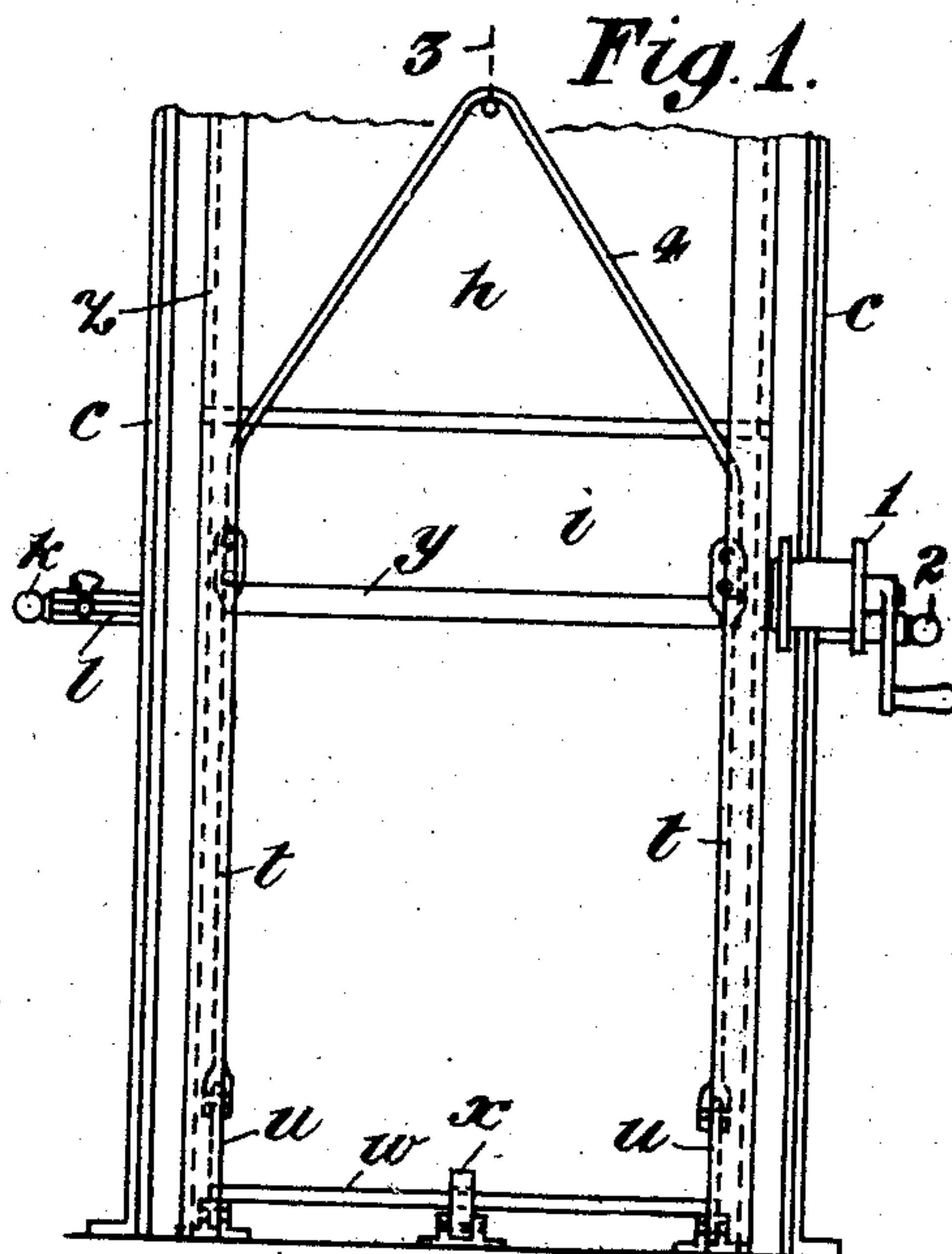


Fig. 1.



Witnesses:-

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UNITED STATES PATENT OFFICE.

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MEANS OR APPARATUS FOR BURNING OR FIXING THE COLORS UPON PRINTED OR DECORATED TILES, GLASS, &c.

No. 854,005.

Specification of Letters Patent.

Patented May 21, 1907.

Application filed December 15, 1905. Serial No. 291,905.

To all whom it may concern:

Be it known that I, LIONEL WARNER STANLEY, a subject of the King of Great Britain and Ireland, residing at 3 Queen's Mead road, Bromley, in the county of Kent, England, have invented new and useful improvements in or relating to means or apparatus for burning or fixing the colors upon printed or decorated tiles, glass, porcelain, and ceramic ware or the like, of which the following is a specification.

This invention has reference to improvements in means or apparatus for burning or fixing by the heat arising from the combustion of a gaseous mixture,—composed, say, of atmospheric air and the vapors of hydrocarbons,—the colors or designs or other matter that have been placed upon or printed upon, or with which tiles, or glass, or porcelain, or ceramic or vitreous ware, or the like, have been decorated.

Hitherto in burning or fixing the color or colors of a design or other matter that has or have been printed or placed by any other means upon the surface of the tile, or piece of glass, or porcelain, or ceramic or vitreous ware, or the like,—all of which are hereafter termed and included in the term "the article,"—it has been found necessary to use either a muffle or a saggar in order to prevent the gases or the products of combustion from damaging the article operated upon, or damaging or blistering the color or colors that has or have been placed upon its surface. The use of a muffle, or saggar entails an unnecessary and useless waste of gas or fuel in heating the same to the required temperature for the burning or fixing operation. Further, when a saggar is used considerable expense in material and labor is involved in producing the same, a new one frequently being required for each operation.

The object of this invention is to dispense with the use of a muffle or a saggar in the burning of the said articles for the purposes named, and to construct a reverberatory furnace which may be heated by the combination of a gaseous mixture, say, for example, composed of a large percentage of atmospheric air and the vapors of hydrocarbons, or other liquids, and in which the article operated upon may be submitted to the direct action of the heat without damaging the article or destroying, or damaging, or changing the

brilliance or tone of the color or colors of the design or other matter.

This invention is designed essentially to provide means for firing wares by means of a combustible mixture of gas, or oil, or spirit vapor, with air, the air being present in such quantity as to be in excess over that required for the complete combustion of the gas or vapor. When subjected to the flame arising from the combustion of such a mixture, the most delicate metallic colors are unharmed and ceramic or vitreous wares can be readily fired without the intervention of a muffle, or the use of a chimney for carrying away the products of combustion. Such a combustible mixture can, however, not be ignited or consumed to advantage in furnaces of ordinary construction. It is necessary that the mixture should be delivered through the nozzles, jets, or burners at a speed greater than the speed of propagation of flame, otherwise the mixture would "fire back." When this speed is attained the mixture will not ignite at the free open end of the conveying pipe, jet, or nozzle, but must be made to impinge upon a refractory substance which must be first warmed, and the angle of impact to obtain the best results should be nearly a right angle, or in other words, the jet of mixture should be nearly perpendicular to the refractory substance. This is more particularly the case when dealing with large volumes of mixture, and the best angle varies with the proportion of combustible vapor present. When so treated the mixture ignites at or about the point of impact, and, (provided the means of egress for the consumed vapor are restricted, so that there is always a very slight excess of pressure in the combustion chamber over the external atmospheric pressure) what is technically known as "flameless combustion" takes place. By varying the volume of gas burned within a given space in a given time, very wide variations of temperature can be obtained, and the furnace or kiln, the subject of this application, is designed to meet all these requirements. It will be particularly noted that the combustible mixture is not ignited when it is directed against the walls or roof (which in the design shown form the refractory substance referred to) but only ignites after impact.

In the accompanying drawings are shown

the refractory substance, the jets arranged at the most suitable angle to give satisfactory results, means of regulating the speed of the issuing combustible mixture and the general construction of the furnace with the absence of special flues provided for the slight excess of pressure in the combustion chamber above mentioned. The products of combustion, completely oxidized, escape through the interstices of the furnace casing and lining and through the space between the loosely fitting sliding door of the furnace.

In the drawings hereunto annexed a reverberatory furnace is shown suitable for carrying this invention into practice, in which:—

Figure 1. is a front elevation. Fig. 2. a side elevation. Fig. 3. a sectional elevation on line A, B, Fig. 4. Fig. 4. a sectional plan on line C, D, Fig. 3.

Like parts in all the views are marked with corresponding letters of reference.

The article to be operated upon may be manufactured or produced, and the design or other matter printed or otherwise placed thereon, by any ordinary or known method. Also the gaseous mixture, with which the hereinafter described furnace is heated, may be produced by the admixture of atmospheric air with the vapors of hydrocarbons, or other liquids, in a carbureter or its equivalent, in the ordinary manner and by known means.

As no claim is made in this specification for either the production of the article to be operated upon, or of the gas by which the furnace is heated, and seeing both methods are well known and will be readily understood by persons conversant with the trade, it has not been deemed necessary to explain them in detail.

The reverberatory furnace suitable for the above named purpose may be constructed as follows:—

The furnace *a* is formed or built of firebrick or fireclay, or other like refractory material *b*, or as at Fig. 3, of a combination of a metal framework or casing *c* with an interior of firebrick or fireclay *b* with or without a lining *d* of asbestos, or slag wool, or plaster of paris, interposed between the framework or casing and the firebrick or fireclay. The interior of the furnace is also, but not necessarily so, lined with asbestos or other like refractory material *e*. The furnace is made of any suitable size, and it is provided with a flat level hearth *f*, formed, say, of firebrick, or fireclay, or plaster of paris, or a combination of two or more of them. The walls and roof *g* of the furnace are in cross section shaped or curved somewhat similar to a D retort, and the rear end is completely closed, while the front end is covered or closed by one or more suitable doors or lids *h*, *i*, or by any other suitable means. It is important that the walls and roof *g* of the furnace should

not be too high and of such a curve that the flames of the said gaseous mixture,—arranged to be admitted on each side of the hearth *f*,—will on ignition readily follow their contour, and the full calorific power of the heat therefrom be readily concentrated on the article operated upon which is placed upon a sliding table *j* above the hearth.

The gaseous mixture for heating purposes is conveyed to the interior of the furnace direct from the carbureter, or other source of supply through pipes or tubes *k* to one or more rows of pipes *l* arranged on each side of and below the level of the hearth. A number of small pipes or jets *m*, which act as burners, are arranged to project from each pipe or tube *l* in an upward and curved or angular direction for causing the said gaseous mixture to first strike against the inner surface of the wall *g* of the furnace for ignition purposes, and afterward the flame follows the contour of the same until about the center of the roof is reached. When the walls and roof of the furnace have been thoroughly heated, an intense heat will,—without smoke or other deleterious effect,—be deflected upon the article operated upon. The pipes *k*, *l*, are provided with taps for regulating the supply of gas.

The upper door *h* is employed for closing the front of the compartment *o*,—above the furnace *a* where space is a consideration,—for preparatory heating purposes. In the compartment are mounted the fixed shelves or guides *n* formed of, say, angle iron upon which a number of removable trays,—not shown in the drawings,—may rest. A second compartment *p* is also provided below the furnace *a* for cooling purposes, and it is open at the front. In this compartment angle iron shelves or guides *q* are fixed for receiving and supporting a number of trays also not shown in the drawings. The lower door *i* is employed for closing the front of the furnace. Any suitable arrangement of mechanism may be employed for opening and closing the said doors. In practice the following arrangement has been found to work satisfactorily, namely:—The door *h* is provided with one or more loops or rings *r* at its upper edge. To each loop or ring *r* a chain or wire or other rope *s* is attached. The chain *s* or its equivalent is carried upward and passed over one or more pulleys and a weight or weights is or are attached to its free end for counter balancing purposes. The pulleys and weights are not shown in the drawings, but may be arranged in any well known method. The door *i* has fixed to each of its sides a pendent rod *t*. The lower ends of the rods *t* are jointed respectively to a double ended lever *u* fulcrumed to the framework at *v*. The outer or heel ends,—that is, the ends away from the rods *t*,—of the two levers *u*, are connected together by a

rod *w*. When the heel or outer ends of the levers *u* are depressed, as shown at Fig. 2, and the rod *w* passed under the catch *x*,—jointed to the framework,—the door *i* will be raised for closing the front of the furnace *a*. As soon as the catch *x* releases its hold upon the rod *w* the door *i* will descend by gravity and the outer or heel ends of the levers *u* will be raised, thereby uncovering the entrance to the furnace.

Suitable holes, with or without covers or lids, may in some cases be provided in the closed ends, or the doors *h*, *i*, of the furnace, for inspection purposes, but such openings are not always necessary, neither are they shown in the drawings.

A rising and falling table *y* is shown at Figs. 1 and 2 mounted in framework *z* on the outside of the furnace at or near its front for facilitating the insertion and withdrawal of the trays *j* upon which the material to be operated upon is placed. The table *y* is made to travel, as required, up or down, by means of a barrel 1 mounted in suitable bearings and rotated by a handle 2, to which ropes or chains 3 are attached and wound. The opposite ends of the ropes or chains after passing over one or more pulleys,—not shown in the drawings,—are connected to loops 4 fixed to the table *y*.

When it is desired, the article to be operated upon is first gradually warmed in one portion, say, compartment *o* above the furnace, before being submitted to the intense heat in the main portion *a* or furnace proper, and afterward allowed to be gradually cooled in a third succeeding portion, say, chamber or compartment *p* below the furnace. Or the same result may be obtained by increasing the length of the furnace *a* and heating to, say, three different degrees of heat at different points thereof. This variation in the heat may be obtained by increasing or diminishing the gas jets as required at the various portions or sections.

The material to be heated is carried on trays *j* which are gradually warmed in, say, a separate compartment *o* which may be heated by the waste gases from the furnace proper before being subjected to the full furnace heat, and subsequently allowed to cool gradually in similar separate compartment *p*. Or various mechanical devices for carrying the material may be arranged to be intermittently propelled forward by hand or power, such as for example, a sliding bed or hearth made in sections, or the hearth may be made somewhat in the form of a grid, parts of which are a fixture and parts made to rise and fall, as well as to be intermittently traversed forward or backward as required. This last named movement may be obtained by an arrangement of cams, levers, and gearing, arranged to be operated by hand or power.

When the movable portions of the hearth in

grid form are at their lowest and normal position the upper surface of the hearth will be as near as possible level.

The material to be operated upon is placed upon trays *j* arranged to slide upon the guides 5 within the furnace and to be supported thereby above the hearth *f*. On the ignition of the gases at the curved ends of the pipes *l* the gas first strikes against the wall *g* where it is ignited. The flame is carried by the curved shape of the furnace to about the center of the roof when on the fire-brick *b* or its lining *e* becoming thoroughly heated the full calorific power of the heat therefrom will be deflected and readily concentrated upon the article operated upon.

What I claim as my invention, and desire to secure by Letters Patent is:—

1. The combination in a reverberatory furnace of the character described, a metal casing divided into three compartments consisting of a central portion composed of refractory material for firing purposes, an upper chamber for preparatory heating purposes, and a lower compartment for cooling purposes; a lining for the metal casing, a recess in the central portion to form a retort closed at its rear end, and having a flat horizontal portion to form a hearth and an arched roof, a lining for the arched roof, a sliding door for closing the mouth of the retort, means for operating said sliding door, a gaseous mixture supply pipe provided with a regulating tap, and having a number of branch pipes in communication therewith on each side of the retort, said branch pipes being each provided with a regulating tap, and having its inner end projecting above the hearth and curved toward the lower portion of the arched roof of the retort, as set forth.

2. The combination in a reverberatory furnace of the character described, a metal casing divided into three compartments consisting of a central portion composed of refractory material for firing purposes, an upper chamber for preparatory heating purposes, and a lower compartment for cooling purposes, a lining for the metal casing, a recess in the central portion to form a retort closed at its rear end, and having a flat horizontal portion to form a hearth and an arched roof, a lining for the arched roof, a sliding door for closing the mouth of the retort, means for operating said sliding door, a gaseous mixture supply pipe provided with a regulating tap, and having a number of branch pipes in communication therewith on each side of the retort, said branch pipes being each provided with a regulating tap, and having its inner end projecting above the hearth and curved toward the lower portion of the arched roof, longitudinal guides upon the hearth, and removable trays containing the articles to be fired, as set forth.

3. The combination in a reverberatory furnace of the character described, a metal casing divided into three compartments consisting of a central portion composed of refractory material for firing purposes, an upper chamber for preparatory heating purposes, and a lower compartment for cooling purposes, a lining for the metal casing, a recess in the central portion to form a retort closed at its rear end, and having a flat horizontal portion to form a hearth and an arched roof, a lining for the arched roof, a sliding door for closing the mouth of the retort, means for operating said sliding door, a gaseous mixture supply pipe provided with a regulating tap, and having a number of branch pipes in communication therewith on each side of the retort, said branch pipes being each provided with a regulating tap, and having its inner end projecting above

the hearth and curved toward the lower portion of the arched roof of the retort, longitudinal guides upon the hearth, removable trays containing articles to be fired, skeleton framework extending in front of the framework of the furnace, a sliding table working in said framework, means for raising and lowering said sliding table, guides for the table in said preparatory heating chamber, a sliding door for closing the last named chamber, means for operating said sliding door, and guides for the trays in the lower compartment, as set forth. 25 30

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses. 35

LIONEL WARNER STANLEY.

Witnesses:

F. HICKMAN,
HORACE COE.