C. O. & E. E. BILLOW.

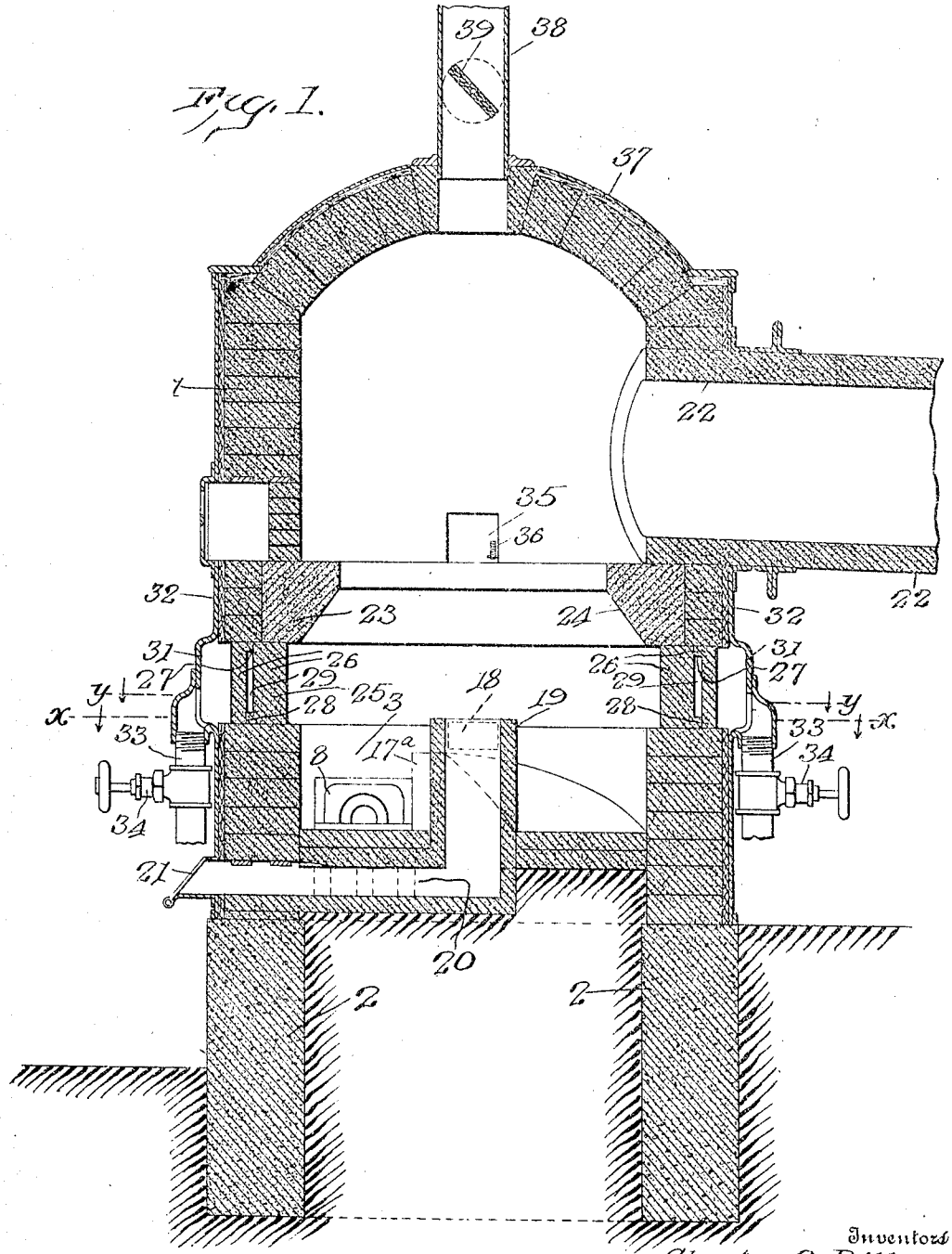
DRIER FURNACE.

APPLICATION FILED MAY 25, 1908.

916,658. Patented Mar. 30, 1909.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses

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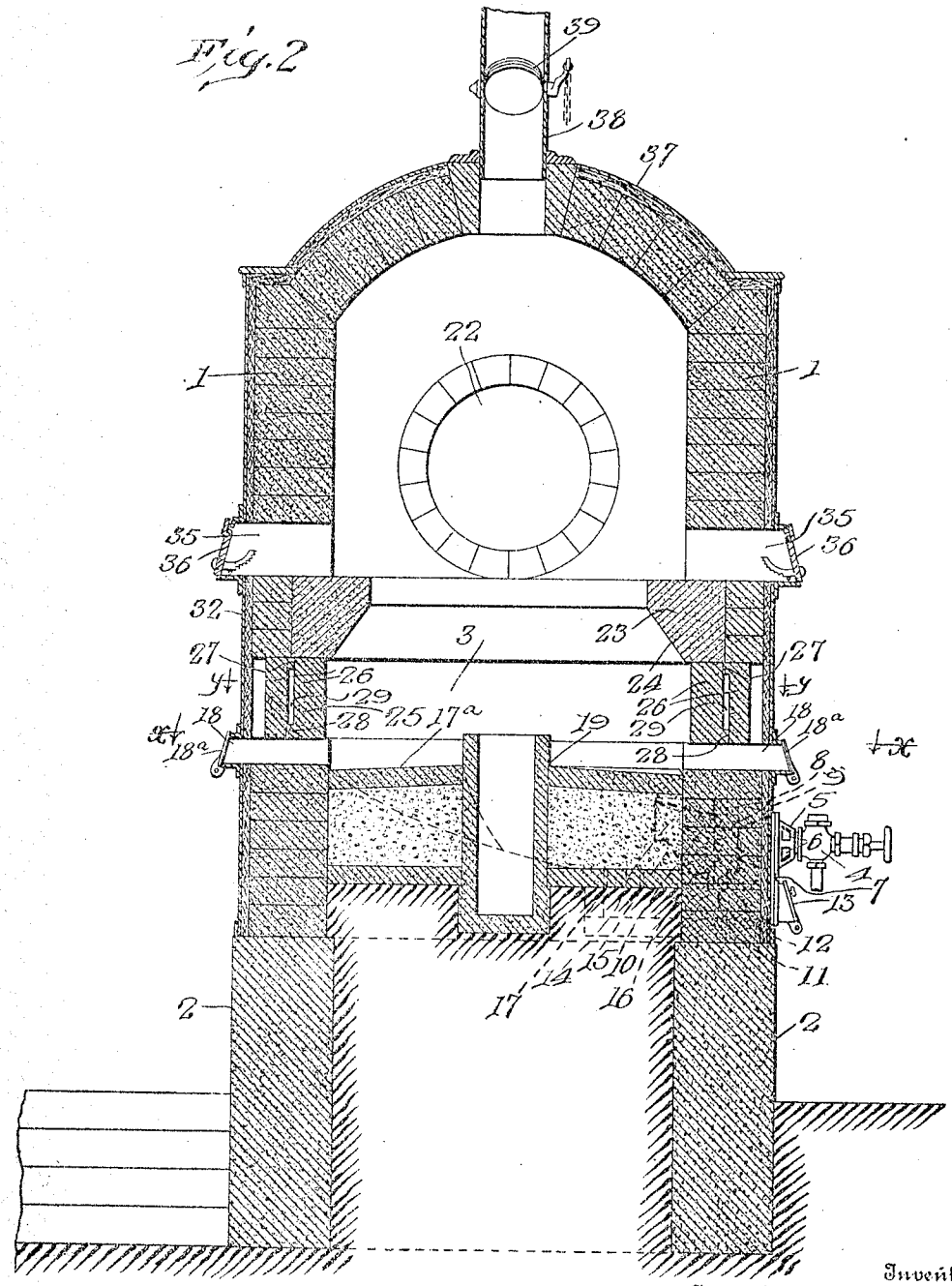
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4 SHEETS—SHEET 2.

Fig. 2



Witnesses

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4 SHEETS—SHEET 3.

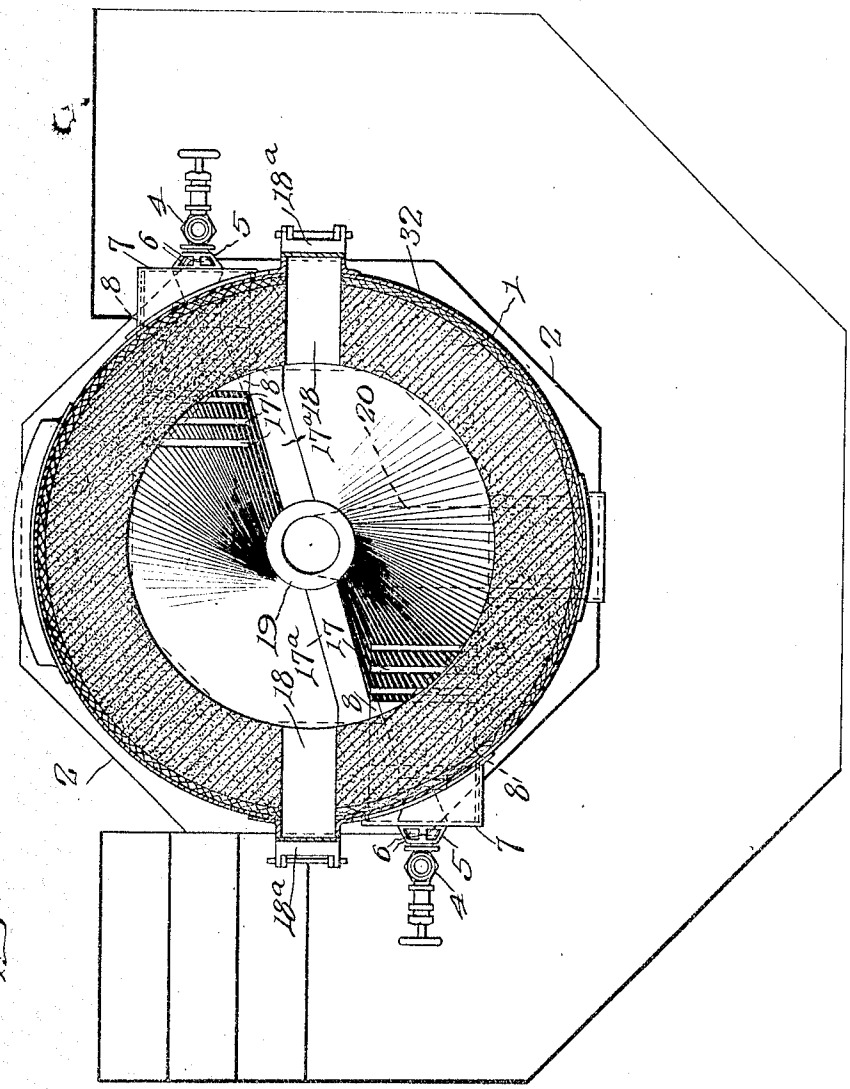


Fig. 3.

Witnesses

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DRIER FURNACE.

APPLICATION FILED MAY 25, 1908.

916,658.

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4 SHEETS—SHEET 4.

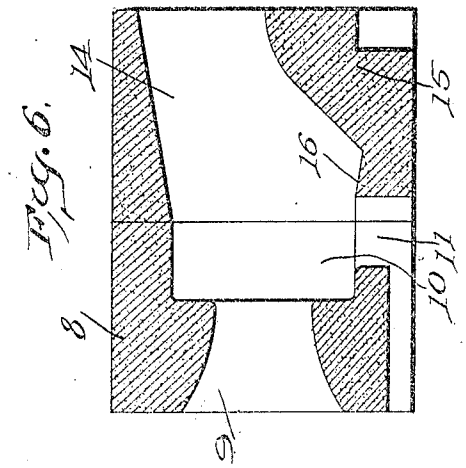


Fig. 6.

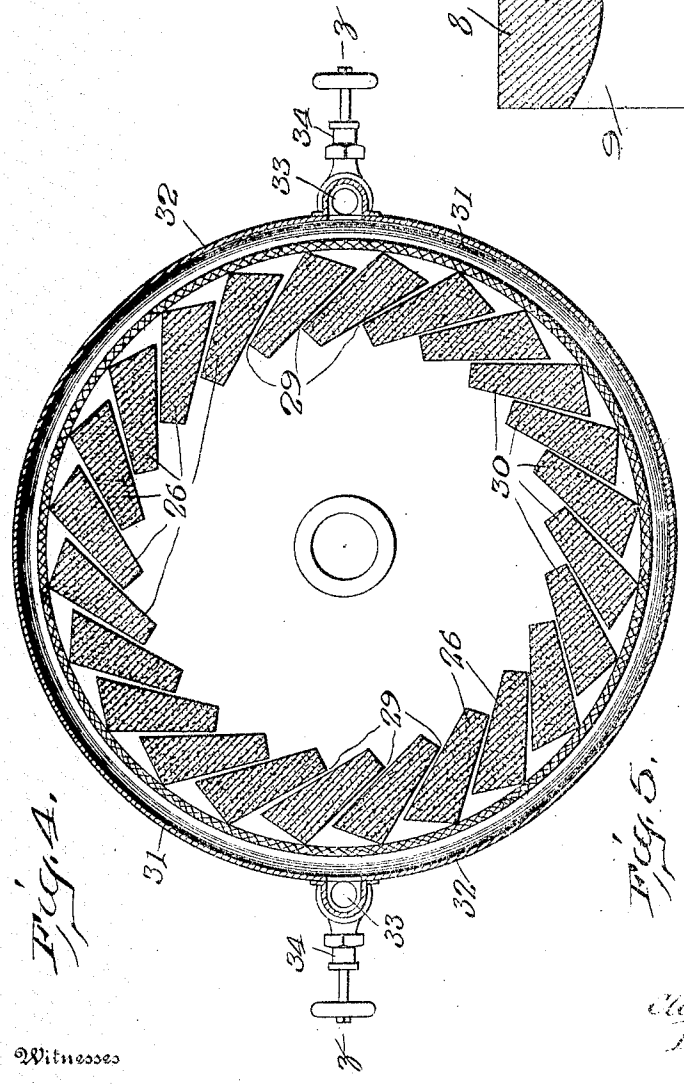


Fig. 4.

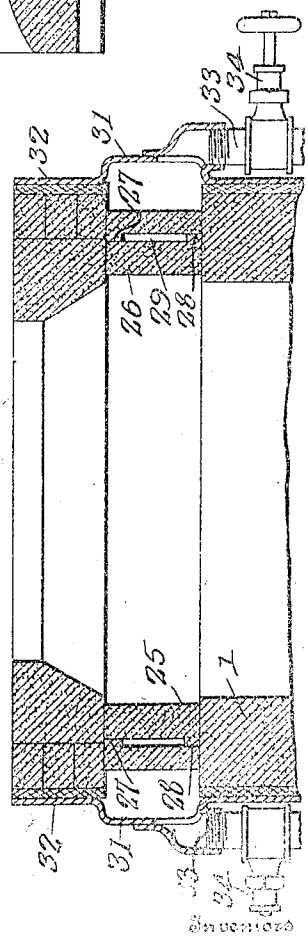


Fig. 5.

Witnesses

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UNITED STATES PATENT OFFICE.

CLAYTON O. BILLOW AND ELMER E. BILLOW, OF CHICAGO, ILLINOIS.

DRIER-FURNACE.

No. 916,658. Specification of Letters Patent. Patented March 30, 1909.

Application filed May 25, 1908. Serial No. 434,306.

To all whom it may concern:

Be it known that we, CLAYTON O. BILLOW and ELMER E. BILLOW, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Drier-Furnaces, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to drier furnaces, and more particularly to furnaces designed for use in connection with driers in which large volumes of highly heated dry air are passed over and through the material to be dried at a considerable velocity.

The object of the invention is to provide a furnace of this character which will occupy but a minimum amount of floor space; which will be so constructed as to permit of a high rate of combustion, thus affording a complete consumption of the fuel and a correspondingly large generation of heat; which will thoroughly mix the air with the products of combustion and thoroughly diffuse the heat generated; which will be so constructed that the heat absorbed and contained in the furnace can be quickly reduced when the fire is extinguished therein.

With these objects in view our invention consists in certain novel features of construction and in certain parts and combinations hereinafter to be described, and then more particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a vertical, sectional view, taken centrally through a furnace embodying our invention; Fig. 2 is a vertical, sectional view, taken centrally through a slightly modified form of the furnace at right angles to the plane on which Fig. 1 is taken; Fig. 3 is a transverse, sectional view of such a furnace taken on the line *x x* of Fig. 1; Fig. 4 is a similar view, taken on the line *y y* of Fig. 1; Fig. 5 is a vertical, sectional view, taken centrally through a portion of the furnace; and Fig. 6 is a detail view of the twyer block.

In these drawings we have illustrated the preferred form of our invention and have shown the furnace as embodying a body portion 1 of fire brick, or other suitable refractory material. This body portion is preferably substantially cylindrical in shape and is supported upon a foundation 2, of concrete or the like, which is preferably surrounded by a pit to enable access to be readily had to any of the parts of the furnace.

This furnace is designed more particularly for use in connection with liquid hydrocarbon or gaseous fuel, and, in the present instance, we have shown the same as provided with suitable means for vaporizing a hydrocarbon and injecting the same with the proper mixture of air into the combustion chamber 3 which is formed in the lower part of the cylindrical body portion of the furnace. Each fuel injector preferably comprises an atomizer 4 which is connected with a hydrocarbon supply and which vaporizes this hydrocarbon under air or steam pressure, air being preferably employed in that it is desirable to deliver the heated air to the drier as free from moisture as possible. This atomizer 4 is supported in a twyer 5 having air inlets 6 and which, in turn, is mounted upon a plate 7 which is secured to the side of the furnace.

Mounted in the wall of the furnace is a twyer block 8 having an inlet opening 9 in alinement with the twyer 5 and preferably having its walls converging inwardly. The twyer block is provided beyond the inlet opening 9 with an enlarged mixing chamber 10 into which the atomizer 4 discharges the vaporized hydrocarbon, together with the air from the twyer 5. This mixing chamber 10 has an inlet 11 in one side thereof, which inlet is in communication with an air passage 12 extending through the wall of the furnace and provided with a controlling door 13 at the outer end thereof. Thus, an adequate amount of air is supplied to the vaporized hydrocarbon to form a highly combustible mixture, which mixture is discharged into the combustion chamber of the furnace through a discharge nozzle 14 formed in the inner end of the twyer block by providing the same with a wall or bridge 15 which reduces the outlet opening, as shown. The inner face of this bridge 15 is preferably inclined downwardly and outwardly and that portion of the lower wall of the mixing chamber 10, which lies between the lower edge of the inner wall of the bridge 15 and the inlet opening 11 for the mixing chamber, is slightly inclined downwardly and inwardly, as shown at 16, and the intersection of the two inclined surfaces forms a receptacle or drip shelf adapted to receive any particles of unvaporized hydrocarbon or any foreign material which may enter the mixing chamber. An air inlet is also provided in the bottom of the combustion chamber near the discharge nozzle of the

twyer block 8 and is adapted to furnish a further supply of air to support the combustion within said combustion chamber. This is preferably accomplished by providing a perforated block or floor space 17 near the discharge end of the nozzle and connecting the same with the inner end of the air passage 12. Hydrocarbon, owing to its very volatile nature, burns with a long flame and requires a considerable space within which to complete its combustion.

In order to afford adequate space for complete combustion of the hydrocarbon, and, at the same time, maintain the furnace within as small a space as possible, we have constructed the same substantially circular in form, as above stated, and have mounted the atomizer 4 tangentially thereof so that the mixture of vaporized hydrocarbon and air will be discharged into the combustion chamber at an acute angle to the walls thereof. This mixture ignites as soon as it is discharged into the combustion chamber and the burning vapor and the accompanying flame is driven by the air pressure, by means of which the hydrocarbon is vaporized, about the inner periphery of the combustion chamber and will, under ordinary pressure, encircle this chamber two or three times, thus affording abundant space for the complete consumption of the hydrocarbon before the vapor has reached the point in the furnace where the temperature of the vapor will be lowered to such a degree that the parts thereof will not readily combine to form a combustible mixture. By thus completely consuming the hydrocarbon we utilize the entire heat energy thereof and generate a correspondingly large amount of heat in the combustion chamber. Two or more injectors are usually employed in each combustion chamber, and, in order that the vapors and products of combustion from one twyer block or injector may not sweep directly across and interfere with the discharge of the next succeeding twyer block, the floor of the furnace is preferably provided with two or more upwardly inclined portions, and, where two injectors are employed, the floor is in the form of a double helix. Each of these inclined portions begins near the discharge nozzle of one of the twyer blocks and is inclined gradually upward and terminates at a point adjacent to and above the discharge nozzle of the next succeeding twyer block as shown at 17ª. Thus, the gases and products of combustion from the first-mentioned twyer block will be raised above the discharge nozzle of the next twyer block, but will not be so elevated as to deflect the same from the combustion chamber. Means are also provided for enabling the operation of the furnace to be observed, and, to this end, we have provided the same with two or more observation ports 18, preferably located adjacent to the atomizers 4 and provided with closures or doors 18ª having mica or similar transparent substance inserted therein, thus enabling the interior operation of the furnace to be observed without the escape of the gases or heat therefrom.

The air to be heated is preferably admitted to the furnace near the center of the combustion chamber and is thus completely surrounded by the combustion chamber and by the burning vapors contained thereby, and, in this manner, is thoroughly heated. In the present instance, the air inlet comprises an upwardly extending flue 19 extending through the bottom of the combustion chamber and upwardly to a point above the uppermost edge of the inclined portions of said bottom. This flue 19 is in communication at its lower end with an air inlet 20 provided at its outer end with a controlling door 21. The discharge end of the flue 19 being at a point considerably above the floor of the combustion chamber, it will be apparent that the incoming air will be discharged into the combustion chamber at such an elevation that the temperature of the lower portion of that chamber will not be materially affected, and, consequently, the temperature of the vapors in the lower portion of the combustion chamber will not be materially lowered or affected in such a manner as to impede the combustion of these vapors.

The air passing from the flue 19 is encircled by and mixed with the burning gases and products of combustion and thus becomes very highly heated and passes upwardly to the outlet or discharge nozzle 22 of the furnace through which it is discharged with a considerable velocity to the drier. Means are provided, however, for thoroughly mixing the air with the products of combustion and for tempering the heat of the air to the desired degree of temperature before it passes out of the furnace. In order that the products of combustion may be thoroughly mixed with the air which passes from the flue 19, we have provided an inwardly extending flange or ring 23, which is supported from the inner walls of the furnace at a point some distance above the upper end of the flue 19 and has its inner edge preferably converging upwardly, as shown at 24. Thus, the products of combustion and the air currents, which circle about the walls of the combustion chamber, are deflected inwardly and caused to become thoroughly mixed with the air which enters through the flue 19. The ring or flange 23, by deflecting these products of combustion and air currents away from the walls of the furnace, prevents the same from sweeping directly across the outlet of the furnace and thus reducing the effectiveness thereof.

In order that the heated air may be tempered to the desired degree of heat, we have

provided in the walls of the furnace a twyer ring 25 which is inserted in the walls of the combustion chamber at a point below the ring or flange 23. This twyer ring preferably comprises a series of tiles 26 arranged on edge in the wall of the furnace and having their adjacent upper and lower surfaces, respectively, provided with inwardly extending lips or flanges 27 and 28, which are so arranged that when the tiles are in position, a series of slots 29 are formed between the several tiles, which slots extend tangentially to the wall of the combustion chamber. The inner edges of the tile preferably extend slightly beyond the wall of the combustion chamber, as shown at 30. The outer side of the twyer ring is inclosed in a suitable hollow casing 31, which, in the present instance, is formed by bending outwardly the metal covering 32 for the furnace. This hollow casing is connected to one or more air supply pipes 33, each of which is provided with a controlling valve 34 and by means of which a regulated supply of air may be introduced into the casing 31 and thence by means of the slotted ring 25 into the combustion chamber. In Fig. 2 the hollow casing 31 is omitted and the metal covering 32 continues in a straight line past the twyer ring. This arrangement provides a somewhat smaller chamber about the twyer ring, but otherwise the furnace is the same as that in Fig. 1. The construction of the twyer casing is such as to enable this air to be introduced into the furnace either under pressure or by an induced or natural draft. By so introducing the air into the combustion chamber we secure a higher rate of combustion and also a more intimate mixture of the air with the heat generated by the burning vapors within the combustion chamber. The burning vapors and air currents circulating about the combustion chamber engage the projecting ends 30 of the tiles 26 forming the twyer ring and are deflected inwardly, thereby causing a further mixture of the air with the heated vapors and preventing the currents of air which are encircling the furnace from interfering with the entrance of the air through the slots of the twyer ring. In order to still further temper the heated air before the same escapes through the outlet 22, there are provided in the walls of the furnace, and preferably above the flange or ring 23, a plurality of air passages 35 provided with means for controlling the same, such as butterfly dampers 36. By adjusting these dampers the amount of air admitted to the furnace can be regulated and the heated air which passes through the outlet thereby tempered.

The furnace is provided with a rounded dome or covering 37 which is preferably in the form of a segment of a sphere and is constructed on such a radius as to radiate or deflect the heat in the dome toward the outlet or nozzle 22, and further, is of such a shape as to focus or accumulate the heated vapors at a point where the incoming air will readily mix with the same.

The character of the furnace herein described is such as to enable the same to be constructed with comparatively thin walls. As a result, the furnace not only occupies a mimimum amount of floor space, but also stores but a minimum quantity of heat within its walls. Drier furnaces as ordinarily constructed have very thick walls, these walls often being as much as two feet in thickness, and while the furnace is heated great quantities of heat are stored in these walls. The drying process is sometimes temporarily interrupted either through the breaking down of the machinery or for other causes. When this occurs the fire in the furnace is extinguished, but in the case of the thick walled furnaces, the large amount of heat stored by the walls thereof is given off and the temperature of the furnace maintained at a very high degree, thus burning the product which remains in the drier and often injuring the drier itself. As above stated, we construct the walls of our furnace comparatively thin and, consequently, they store but a comparatively small amount of heat which is quickly given off when the fires have been extinguished. To still further facilitate the reducing of the temperature of the furnace when such reduction is desired, we have provided the furnace with an outlet pipe 38 connecting the same with the open air. This pipe is preferably mounted in the uppermost portion of the dome or cover for the furnace and is provided with a damper 39 for controlling the same. Consequently, when it is desired to reduce the temperature in the furnace and the fire has been extinguished, it is only necessary to open this outlet and the heated air will immediately escape therefrom, and, inasmuch as the walls have stored but a small amount of heat, the temperature of the furnace will be speedily reduced.

The operation of the furnace will be readily understood from the foregoing description, and, inasmuch as the economic distribution and diffusion of heat in a furnace are controlled to a large extent by the lines or contour thereof and the efficiency of such a furnace is largely due to its ability to reverberate the products of combustion in such a manner that the elements which produce complete combustion may be thoroughly mixed, it will be apparent that we have provided a furnace having a maximum efficiency both as to the production of heat and as to its distribution, and, to secure this efficiency, we have provided a furnace of such a construction that the flames and burning vapors which are injected into the combustion chamber will be caused to circulate about

that chamber until the vapors and gases are completely consumed and provision has been made to prevent the vaporized hydrocarbon injected at one point from interfering with the injection of the vaporized hydrocarbon at other points about the circumference of the combustion chamber; further, that the air to be heated is introduced into the combustion chamber in such a manner that it is entirely surrounded by that combustion chamber and the burning vapors therein, is thoroughly mixed with the products of combustion and absorbs the heat generated by said combustion; that the air, which is thus heated, is tempered by the admission of free air thereto to bring the same to the desired degree of temperature sought in the drier; and further, that the furnace is of such a construction that it will store within its walls but a small amount of heat and that it is provided with means for rapidly reducing the temperature thereof when the fire has been extinguished or withdrawn therefrom. Further, it will be apparent that we have provided an injector comprising an atomizer and mixing chamber which are peculiarly adapted for use in connection with this furnace and which are so arranged therein as to afford the greatest possible efficiency in the injection of fuel into the combustion chamber.

We wish it to be understood that we do not desire to be limited to the details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus fully described our invention, what we claim as new and desire to secure by Letters Patent, is:—

1. A furnace of the character described comprising a body portion having an air inlet, and an air outlet above said air inlet, a combustion chamber adjacent to said air inlet, and means located between said inlet and said outlet for tempering the air which is heated in said combustion chamber before it passes through said outlet.

2. A furnace of the character described comprising a body portion having a combustion chamber in the lower part thereof, an air inlet arranged in said combustion chamber, an outlet in said body portion above said inlet, and means located between said inlet and said outlet for tempering the heated air.

3. A furnace of the character described comprising a body portion having a combustion chamber in the lower portion thereof, and an air inlet centrally arranged in said combustion chamber, said body portion having an air outlet above said air inlet, and means for tempering the air as it passes from said inlet to said outlet.

4. A furnace of the character described comprising a body portion having a combustion chamber in the lower portion thereof, an air inlet centrally arranged in said combustion chamber and comprising a flue extending some distance above the bottom of said chamber, said body portion having an outlet above the upper end of said flue, and means located between said flue and said outlet for tempering the heated air before it passed through said outlet.

5. A furnace of the character described comprising a body portion, an air inlet centrally arranged in said body portion near the bottom thereof, a combustion chamber surrounding said air inlet, an air outlet in the upper part of said body portion, means for tempering the air as it passes from said inlet to said outlet, and means located between said air inlet and said air outlet for causing the products of combustion to mix with said air before it passes through said outlet.

6. A furnace of the character described comprising a body portion, an air inlet centrally arranged in said body portion near the bottom thereof, a combustion chamber surrounding said air inlet, an air outlet in the upper part of said body portion, means for tempering the air as it passes from said inlet to said outlet, and a flange extending inwardly from the walls of said body portion and having upwardly converging walls, whereby the products of combustion are caused to mix with said air before said air passes through said outlet.

7. A furnace of the character described comprising a body portion having a combustion chamber, fuel injectors arranged to discharge the fuel into said combustion chamber under pressure and at an acute angle to the walls thereof, and means for deflecting the fuel from one of said injectors above the discharge end of another injector.

8. In a furnace of the character described, a body portion having a combustion chamber, fuel injectors arranged to discharge the fuel into said combustion chamber under pressure and at an acute angle to the walls thereof, the bottom of said combustion chamber having upwardly inclined portions arranged between the adjacent fuel injectors.

9. In a furnace of the character described, the combination, with a body portion having a combustion chamber, fuel injectors arranged to discharge the fuel into said combustion chamber under pressure and at an acute angle to the walls thereof, and a flue extending upwardly from the bottom of said combustion chamber, said bottom of said combustion chamber having upwardly inclined portions arranged about said flue and between the adjacent fuel injectors, the upper edges of said inclined portions being below the upper end of said flue.

10. A furnace of the character described comprising a body portion having a combus-

tion chamber, an air inlet arranged within said combustion chamber, an outlet formed in said body portion, and a twyer ring mounted in the walls of said furnace between said air inlet and said air outlet.

11. A furnace of the character described comprising a body portion having a combustion chamber, an air inlet arranged within said combustion chamber, an outlet formed in said body portion, and a twyer ring mounted in the walls of said furnace between said air inlet and said air outlet, and having a plurality of openings arranged tangentially to the walls of said furnace.

12. A furnace of the character described comprising a body portion having a combustion chamber, an air inlet near the bottom of said body portion, an outlet formed in said body portion above said inlet, and a twyer ring mounted in the walls of said body portion and comprising a plurality of tiles arranged at an angle to the wall of said furnace and having slots formed between the same.

13. A furnace of the character described comprising a body portion having a combustion chamber, an air inlet near the bottom of said body portion, an outlet formed in said body portion above said inlet, and a twyer ring mounted in the walls of said body portion and comprising a plurality of tiles having their inner ends extending at an acute angle to said wall and beyond the inner face thereof and having slots formed between the adjacent tiles.

14. A furnace of the character described comprising a body portion having an air inlet and an air outlet, a combustion chamber, a twyer ring mounted in the wall of said body portion and having its slots extending at an acute angle to the wall thereof, and a casing inclosing the outer edge of said twyer ring, and an air supply pipe connected to said casing.

15. A furnace of the character described comprising a body portion having a combustion chamber, an air inlet near said combustion chamber, an air outlet, means located between said air inlet and said air outlet for deflecting the products of combustion toward the center of said furnace, an air passage formed in the wall of said body portion above said deflecting means, and means for controlling the admission of air to said passage.

16. A furnace of the character described comprising a body portion having a combustion chamber, an air inlet, an air outlet above said air inlet, and a closure for the upper end of said body portion having an opening therein, and means for controlling said opening.

17. A furnace of the character described comprising a substantially cylindrical body portion having a combustion chamber, an air inlet, an air outlet above said air inlet, means for tempering the air as it passes from said inlet to said outlet, and a dome-shaped closure for said body portion.

18. A furnace of the character described comprising a substantially cylindrical body portion having a combustion chamber, an air inlet, an air outlet above said air inlet, a dome-shaped closure for said body portion having an outlet pipe, and a cut-off in said pipe.

19. In a furnace of the character described, the combination, with a body portion having a combustion chamber, of a fuel injector mounted in the wall of said body portion and comprising an atomizer, a twyer block mounted in the wall of said body portion and having an opening in alinement with said atomizer, and a mixing chamber formed therein beyond said opening.

20. In a furnace of the character described, the combination, with a body portion having a combustion chamber, of a twyer block mounted in the wall of said body portion and having a mixing chamber therein, an inlet to said mixing chamber, a twyer mounted in alinement with said inlet, and an atomizer mounted in said twyer and adapted to discharge into said mixing chamber.

21. In a furnace of the character described, the combination, with a body portion having a combustion chamber, and an atomizer mounted in the wall of said body portion, of a twyer block mounted in alinement with said atomizer and having a mixing chamber formed therein, said mixing chamber having an air inlet independent of said atomizer.

22. In a furnace of the character described, the combination, with a body portion having a combustion chamber, and an atomizer adapted to discharge into said combustion chamber, of a twyer block supported in alinement with said atomizer and having a mixing chamber, a bridge at the inner end of said twyer block, and a drip shelf formed within said mixing chamber.

23. A furnace of the character described comprising a substantially cylindrical body portion having a combustion chamber in the lower portion thereof, an air inlet centrally arranged within said combustion chamber, fuel injectors arranged tangentially of said combustion chamber, an outlet formed in said body portion above said inlet, a flange extending inwardly from the walls of said body portion between said inlet and said outlet and having an inwardly inclined inner edge, an air passage formed in the wall of said body portion between said inlet and said outlet, and means controlling said air passage.

24. A furnace of the character described comprising a substantially cylindrical body portion having a combustion chamber in the lower part thereof, an air inlet comprising a flue arranged centrally of said combustion

chamber and extending above the bottom thereof, fuel injectors mounted in the wall of said body portion and arranged at an acute angle thereto, a twyer ring mounted in the wall of said body portion above said fuel injectors, a flange extending inwardly from the wall of said body portion above said twyer ring, an air passage formed in the wall of said body portion above said flange, means for controlling the passage of air through said air passage, a closure for said body portion, an outlet in said closure, means for controlling said outlet, and an air outlet in the said body portion.

25. A furnace of the character described comprising a body portion having a combustion chamber, an air inlet arranged within said combustion chamber, an outlet formed in said body portion, and a twyer mounted in the wall of said furnace between said air inlet and said air outlet.

In testimony whereof, we affix our signatures in presence of two witnesses.

CLAYTON O. BILLOW.
ELMER E. BILLOW.

Witnesses:
CHARLES F. FOSTER,
J. HENRY MEYERS.