V. MULHOLLAND.

LEER.

APPLICATION FILED JUNE 12, 1909.

1,071,331.

Patented Aug. 26, 1913.

4 SHEETS—SHEET 1.

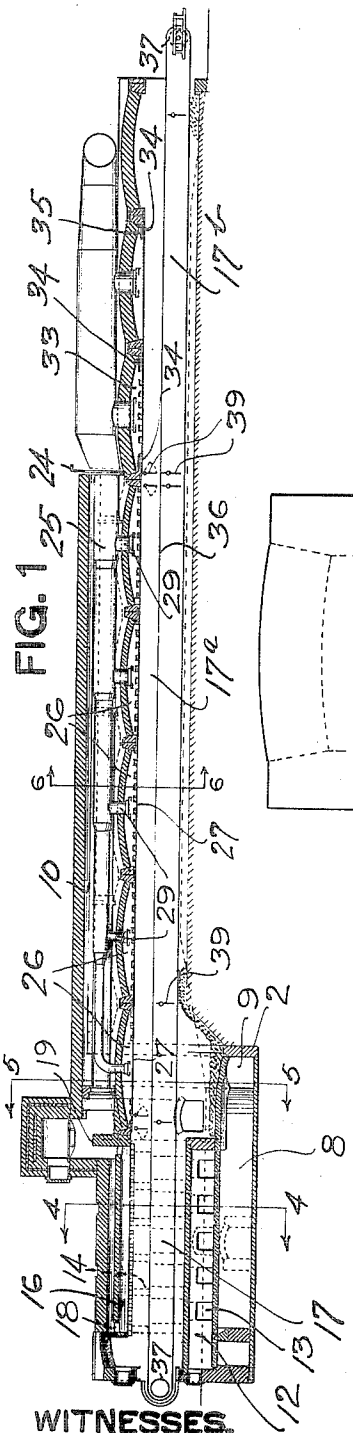

FIG. 1

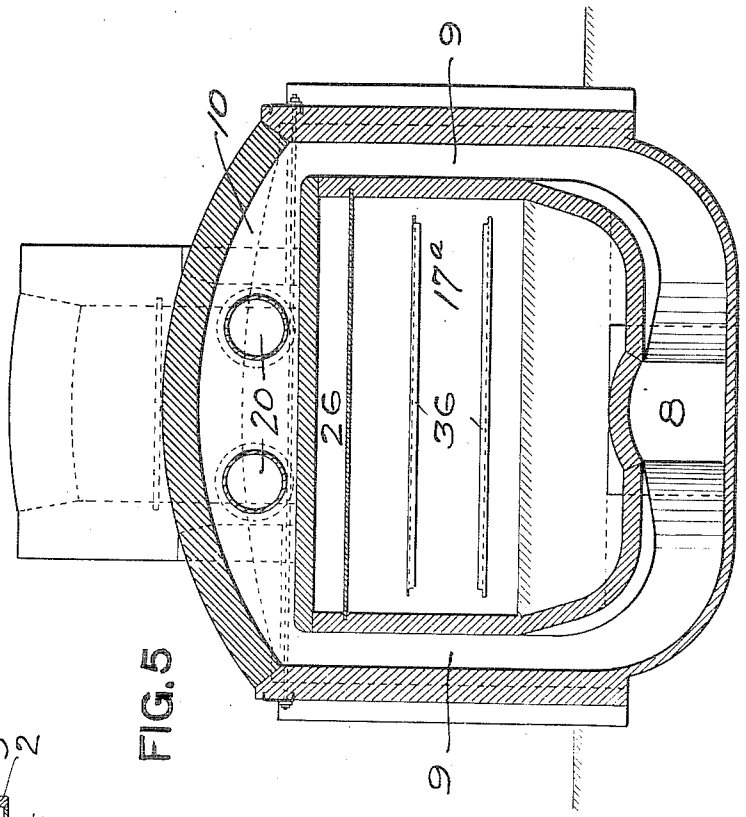

FIG. 5

WITNESSES.

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4 SHEETS—SHEET 2.

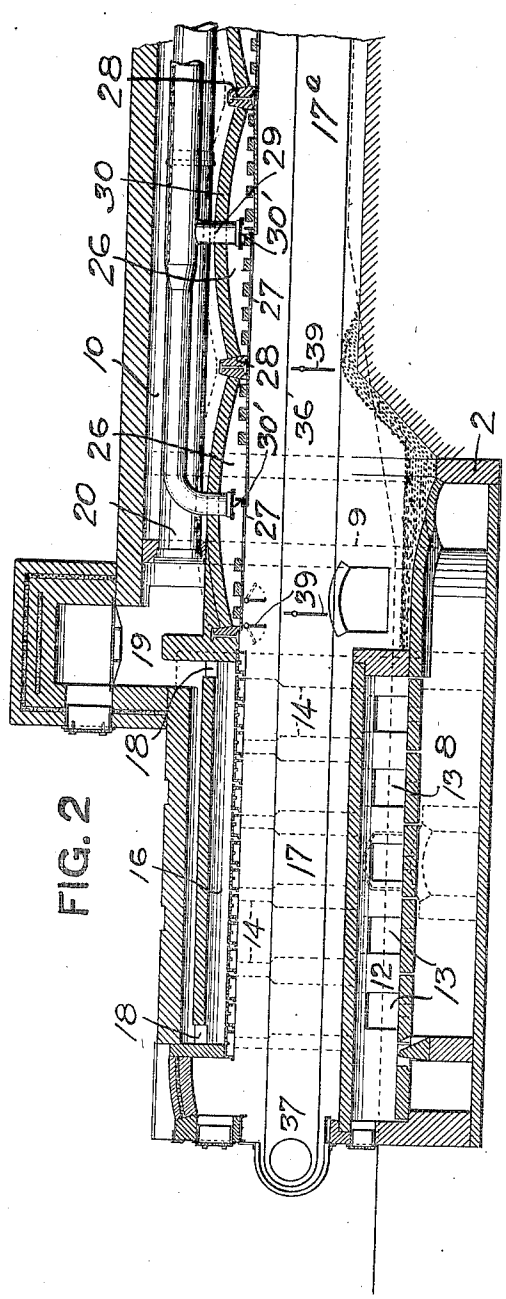

FIG. 2

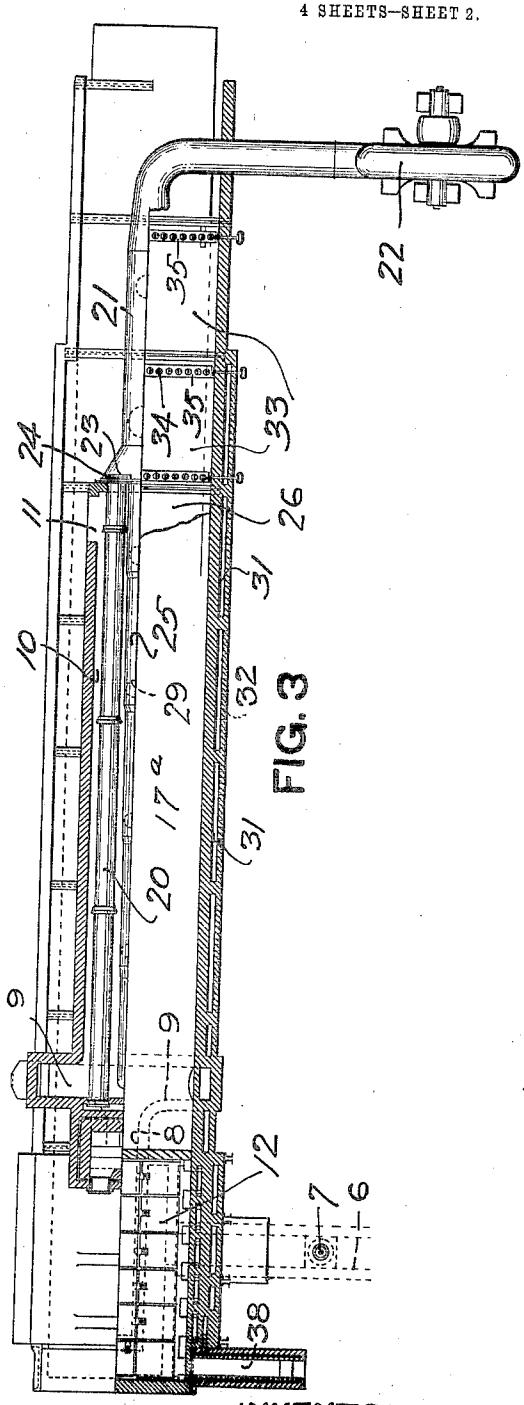

FIG. 3

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4 SHEETS—SHEET 3.

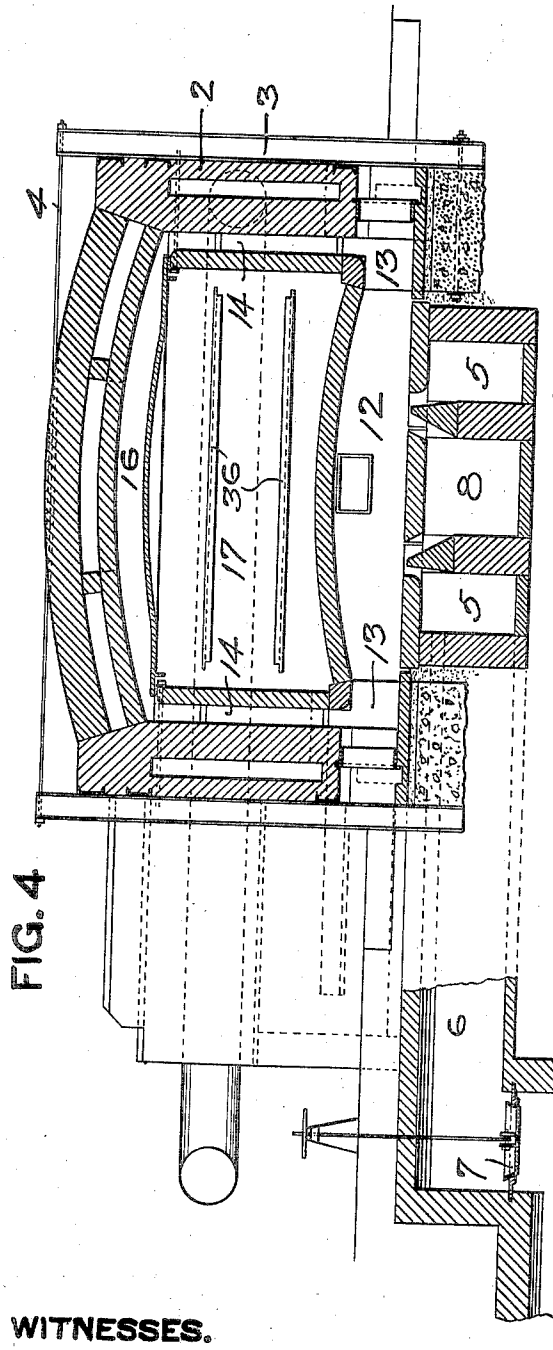

FIG. 4

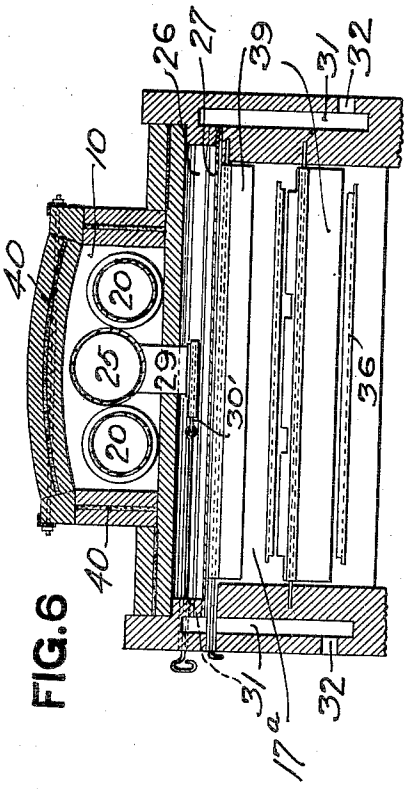

FIG. 6

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LEER.

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4 SHEETS—SHEET 4.

FIG. 7

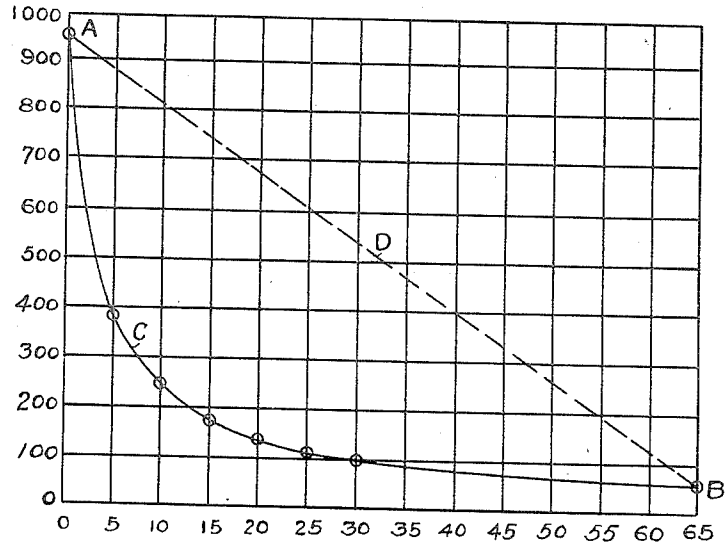
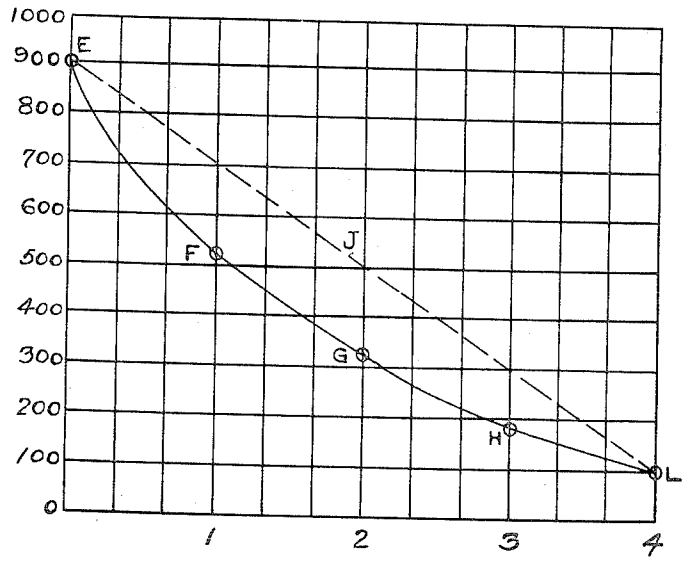


FIG. 8



WITNESSES.

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UNITED STATES PATENT OFFICE.

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LEER.

1,071,331. Specification of Letters Patent. Patented Aug. 26, 1913.

Application filed June 12, 1909. Serial No. 501,810.

To all whom it may concern:

Be it known that I, VERGIL MULHOLLAND, a resident of Edgewood, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Leers; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the process of annealing glassware as well as to the leer employed in connection therewith.

The main object of my invention is to provide a process, whereby the temperature of the glass annealed may be brought from that required for its proper annealing down to the ordinary temperature of the atmosphere at an even rate of cooling, that is, the temperature is lowered the same number of degrees in each succeeding unit of time.

My invention will be fully described and claimed in connection with the following description and claims.

In the drawings Figure 1 is a longitudinal sectional elevation of my improved leer; Fig. 2 is an enlarged vertical section of a portion of same; Fig. 3 is a part plan and part horizontal section of same; Fig. 4 is a section on the line 4—4 Fig. 1; Fig. 5 is a section on the line 5—5 Fig. 1; Fig. 6 is a section on the line 6—6 Fig. 1; and Figs. 7 and 8 are diagrammatic views showing the natural rate of cooling, the ordinary rate of cooling and the even rate of cooling, as obtained by the practice of my invention.

In the drawings the numeral 2 designates the brick and tile work of which my improved leer is constructed, the parts being held and tied together by suitable frame work 3 composed of angle bars connected together by tie rods 4. The gas flues 5, as shown in Fig. 4, are connected up with the main gas flue 6 controlled by a suitable valve 7. Natural gas or producer gas may be employed as fuel. The air-flue 8 is supplied with air from the air-flue 9 connected up with the air intake chamber 10 which is open to the atmosphere at 11. The air and gas admitted in this way enter the combustion chamber 12 where the combustion takes place. The heated products of combustion pass out through the ports 13 and up the flues 14 to the space 16 above the annealing chamber. The annealing chamber for purposes of description may be said to be divided into three sections 17, 17ª and 17ᵇ for the reason more fully hereinafter set forth. From this chamber 16 the products of combustion escape by the flues 18 over the wall 19 to the inlet through the pipes 20 located in the intake chamber 10. These pipes 20 furnish the draft for the combustion chamber and said pipes extend back where they open into the main 21 which is supplied with the blower 22. Dampers 23 are provided in the draft pipes 20 to control the draft, said dampers being operated by the handles 24.

Within the air intake chamber 10 is the pipe 25, said pipe being composed of sections gradually increasing in diameter. The inner end of the pipe 25 is connected up with the chamber 26 which is separated from the section 17ª of the annealing chamber by the plate 27. There are a series of such chambers 26 extending along the section 17ª of the annealing chamber and said chambers are separated from each other by the dividing walls 28. The pipe 25 has the connections 29 which pass up through the top walls 30 of the chambers 26 and these connections gradually increase in diameter. The top 30 of the chambers 26 is preferably formed of metal as better radiation of the heat is obtained and the air in the chambers 26 is more effective in the cooling of the ware. Each connection is provided with a suitable damper 30′. Air is supplied to the chambers 26 from flues 31 in the side walls, said flues having the air inlet ports 32. The pipe 25 also opens into the large main 21 and is subject to the suction action of the blower 22.

At the outer or delivery end of the leer are the chambers 33 similar to the chamber 26 but not provided with air inlet ports 32 as in the case of the chambers 26. These chambers 33 are connected up with the large main 21. The chambers 33 have openings 34 which open communication between said chambers 33 and the open end of the section 17ᵇ of the annealing chamber, said openings being controlled by dampers 35. As the outer end of the annealing chamber is open the cold air coming in the said opening may be drawn up through the openings 34 into the chambers 33 when the dampers 35 are opened.

Within the annealing chamber are the leer pans 36 which are carried by an endless conveyer passing around sprocket wheels 37 at each end of the leer, one of said sprocket wheels being driven from a

suitable source of power. The ware is introduced to the leer pans through the opening 38.

Arranged at intervals within the annealing chamber are the swinging curtains or baffles 39 for the purpose of preventing circulation or draft of air in the main ware chambers 17 and 17^a, thus allowing a more exact regulation of temperature and also confining any air circulation to the space 17^b under the chambers 33, and insuring the air supply for chambers 33 coming from the rear or discharge end of the leer.

From the well known laws of cooling as set forth by the authorities, such as Piclet and Dulong, the natural rate of cooling of an object of glassware, taken at a red heat and placed where the air and surrounding objects are at the ordinary temperature of the atmosphere, may be expressed diagrammatically, as in Fig. 7 where the temperature in degrees is plotted against the time required for cooling and in which the full curved line A, C, B, represents the natural rate of cooling, while the dotted straight line A, D, B, represents an even rate of cooling. From this diagram it will be observed that the rate of cooling in the beginning of the process is very much more rapid than that during the last stages. In the ordinary process commonly practised for the annealing of glass ware this too rapid rate of cooling in the first of the process is partly overcome by maintaining the air and surrounding walls of the leer at a temperature nearer that of the glass to be cooled. Such process, or the leers used therewith, fail to provide, however, for any means of increasing the natural rate of cooling as the lower temperatures are reached where the natural cooling rate is much less than an average rate would be. This necessitates the allowing of a greater rate of cooling than the average at the higher temperatures to compensate for less than the average rate, which is all that can be obtained at the lower temperatures in order that the ware may reach the temperature desired at the completion of the process. This may be illustrated diagrammatically, as shown in Fig. 8, which is taken from an average of actual measurements and in which the temperature in degrees Fahrenheit of the ware is plotted against the time consumed in cooling. The full curved line E, F, G, H, represents the actual rate of cooling, while the dotted line E, J, L, represents an average or even rate of cooling. It will be observed from Fig. 8 that an even cooling rate is 200° per hour, while the actual rate, according to the process at present practised, is about 380° in the first hour, or almost twice the average or even rate of cooling, and in the last hour the actual rate is only 90°, or less than half the average or even rate. Obviously far better annealing results will be obtained if the rate of cooling is even and I obtain this result by the method of first retarding the natural rate of cooling to make it coincide with the average rate until the two naturally coincide and then accelerate the natural rate of cooling to keep it coincident with the average rate of cooling until the final desired temperature is reached.

My process will be well understood in connection with the practical operation of the above described leer and I will proceed to describe the operation of said leer in connection with the annealing of glassware.

When my improved leer is in use the gas is turned on to enter the gas-flues and the air supply through the air-flues mixes with the gas and said air and gas are ignited in the combustion chamber 12. The heated products of combustion surround the section 17 of the annealing chamber adjacent to the place where the ware is introduced so as to maintain that portion of the leer at such a temperature as will maintain or raise the ware when introduced at or to a proper uniform degree of heat. If the ware is at the proper temperature when introduced into the leer it will accordingly be maintained at that temperature for the time being, or if not at proper temperature it will be raised to such proper temperature by the heat within the annealing chamber. It will be understood that it is most essential and desirable to have all parts of the ware equally heated before the process of cooling begins so that by a gradual cooling of the ware as it proceeds through the annealing chamber all the parts will be cooled uniformly and internal strains avoided. The products of combustion pass up and escape through the combustion draft-flues 20, being drawn off into the large main 21 by the blower 22. The section 17 of the annealing chamber is surrounded on four sides by the heated products of combustion and the top of said chamber will become highly heated and the heat radiated therefrom will heat the chamber 17. Furthermore, there will be no drafts or currents in the annealing chamber as the heated products of combustion do not pass directly through said chamber and consequently there will be no deposit on the ware which is liable to occur where producer gas is employed. The air used for combustion coming in at 11 and passing through the chamber 10 surrounds the heated pipes 20 and 25 carrying respectively the products of combustion and the air used for cooling, and so absorbs some of the heat which would otherwise be wasted, thereby raising the temperature in the combustion chamber and resulting in considerable saving in fuel.

As is well known, it is essential for the

proper annealing of ware to control the rate of cooling in such a manner that there will be a gradual reduction in the temperature of the ware from the front end of the leer to the discharge end and I obtain a very accurate control in this respect. The insulation of the section 17ª is such that the natural rate of cooling would be slower than desired, but by the pipe 25 which connects up to the chambers 26 I carry off the excess heat by admitting air from the outside through the flues 31. This insulation of the section 17ª referred to is due to the air space in the side walls forming the flues 31 and the use of the asbestos 40 interposed between the walls as indicated in Fig. 6. The heat given off by the ware in the leer will radiate through the plate 27 forming the top of the annealing chamber 17ª and heat the air in the chamber 26. The amount of heat absorbed from the ware in this manner is controlled by the amount of air admitted by the flues 31 and allowed to pass through the chamber 26 which is regulated by the damper 30. The pipe 25 carries off the air from these chambers and there is a constant circulation and introduction of fresh air into said chambers. The forced draft created by the blower 22 remains constant and the draft from the chambers 26 is not affected by outside atmospheric conditions. The size of the connections leading from the chambers 26 to the pipe 25 increases as the discharge end of the leer is approached because a greater volume of air is of necessity carried through each succeeding chamber 26 as the discharge end is neared in order to carry the same quantity of heat from each chamber. This is due to the fact that the temperature of the ware, the top plate, etc., is being gradually reduced and consequently it requires a greater volume of air in each succeeding chamber 26 to absorb the necessary heat units to reduce the temperature of the ware. In this way the temperature of the ware is gradually lowered so that all parts cool at an equal rate and internal strains are avoided. After a certain temperature has been reached the cooling in the manner above set forth is no longer adequate and further cooling is effected by the air entering the discharge end of the leer which is drawn directly over the ware and carried up and out through the openings 34 into the large main 21 controlled by dampers 25. By such dampers the volume of air is so controlled that a less volume of air passes over each succeeding section 33 from the discharge end in.

By my invention I obtain a gradual reduction in the temperature from that which is just below the point where the ware would be distorted by the heat to that of the outside air and this is accomplished without introducing the products of combustion directly into the annealing chamber which often carry more or less solid matter which is deposited on the ware and necessitates the washing of the ware to remove it. Furthermore, the heat contained within the annealing chamber is not subject to variations caused by the temperature and humidity of the outside air, or even changes in the direction of the wind, and consequently there is not the same care required in controlling the heat of the leer.

By my invention I make use of the waste heat of the products of combustion for heating the air used for combustion and thus secure a higher temperature in the fire chamber while at the same time I am enabled to secure proper temperature in the annealing chamber 17ª due merely to the radiation of the heat from the fire box through the walls of the flue.

What I claim is:

1. The method of annealing glassware consisting in retarding the natural rate of cooling up to a point where the natural rate of cooling and the desired rate of cooling coincide, or substantially coincide, and then accelerating the natural rate of cooling from that point on.

2. The method of annealing glassware, consisting in bringing the same to an even, or substantially even, temperature throughout, retarding the natural rate of cooling in the first stages of the annealing up to a certain point, and then accelerating the natural rate of cooling from that point on.

3. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air chambers above said annealing chamber, said air chambers and annealing chamber being non-communicating, and means for drawing the air from said air chamber.

4. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air chambers above said annealing chamber, a heat conductor separating said annealing chamber from said air-chambers, and means for drawing off the air from said air-chambers.

5. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air-chambers above said annealing chamber, a metal plate separating said annealing chamber from said air chambers, and means for drawing off the air from said air-chambers.

6. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air-chambers above the said annealing chamber, said air chambers and annealing chamber being non-communicating, an exhaust pipe, and connections between said exhaust pipe and said air-chambers.

7. A leer for glassware comprising an

annealing chamber, means for heating the same, a series of air-chambers above said annealing chamber, and means for drawing off increased quantities of air from each succeeding air-chamber.

8. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air chambers above said annealing chamber, an exhaust pipe, and connections between said exhaust pipe and said air chambers, said connections from said exhaust pipe to said air-chambers gradually increasing in size toward the discharge end of said leer.

9. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air chambers above said annealing chamber, an exhaust pipe, connections between said exhaust pipe and said air chambers, said pipe gradually increasing in diameter toward the discharge end of said leer.

10. A leer for glassware, comprising an annealing chamber, means for heating the same, a series of air chambers above said annealing chamber, means for supplying the same with air, an exhaust pipe, connections between said exhaust pipe and each of said air chambers and dampers in said connections.

11. A leer for glassware comprising an annealing chamber, an air intake flue extending longitudinally of the leer along the annealing chamber and communicating with the combustion chamber, means for supplying gas to the combustion chamber, a pipe for the products of combustion passing through said air intake flue, a series of air chambers above said annealing chamber, means for supplying the said air chambers with air, a pipe extending through said air intake flue, connections between said pipe and each of said air chambers, a main pipe into which said pipes discharge, and an exhauster connected up with said main pipe.

12. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air chambers above said annealing chamber, means for supplying the same with air, an exhaust pipe, connections between said exhaust pipe and said air chambers, said annealing chamber having communication with certain of said air chambers at the discharge end of said annealing chamber, means for controlling said communication and means for admitting air at the discharge end of said annealing chamber.

13. A leer for glassware comprising an annealing chamber, means for heating the same, a series of air chambers above said annealing chamber, means for supplying the same with air, an exhaust pipe and connections between said exhaust pipe and said air chambers, said annealing chamber having openings leading into certain of said air chambers at the discharge end of said annealing chamber, dampers controlling said openings and means for admitting air at the discharge end of said annealing chamber.

In testimony whereof, I the said VERGIL MULHOLLAND have hereunto set my hand.

VERGIL MULHOLLAND.

Witnesses:
ROBT. D. TOTTEN,
ROBERT C. TOTTEN.