C. BOLLINGER.

RECIRCULATION SYSTEM.

APPLICATION FILED AUG. 3, 1916.

1,254,650.

Patented Jan. 29, 1918.

5 SHEETS—SHEET 1.

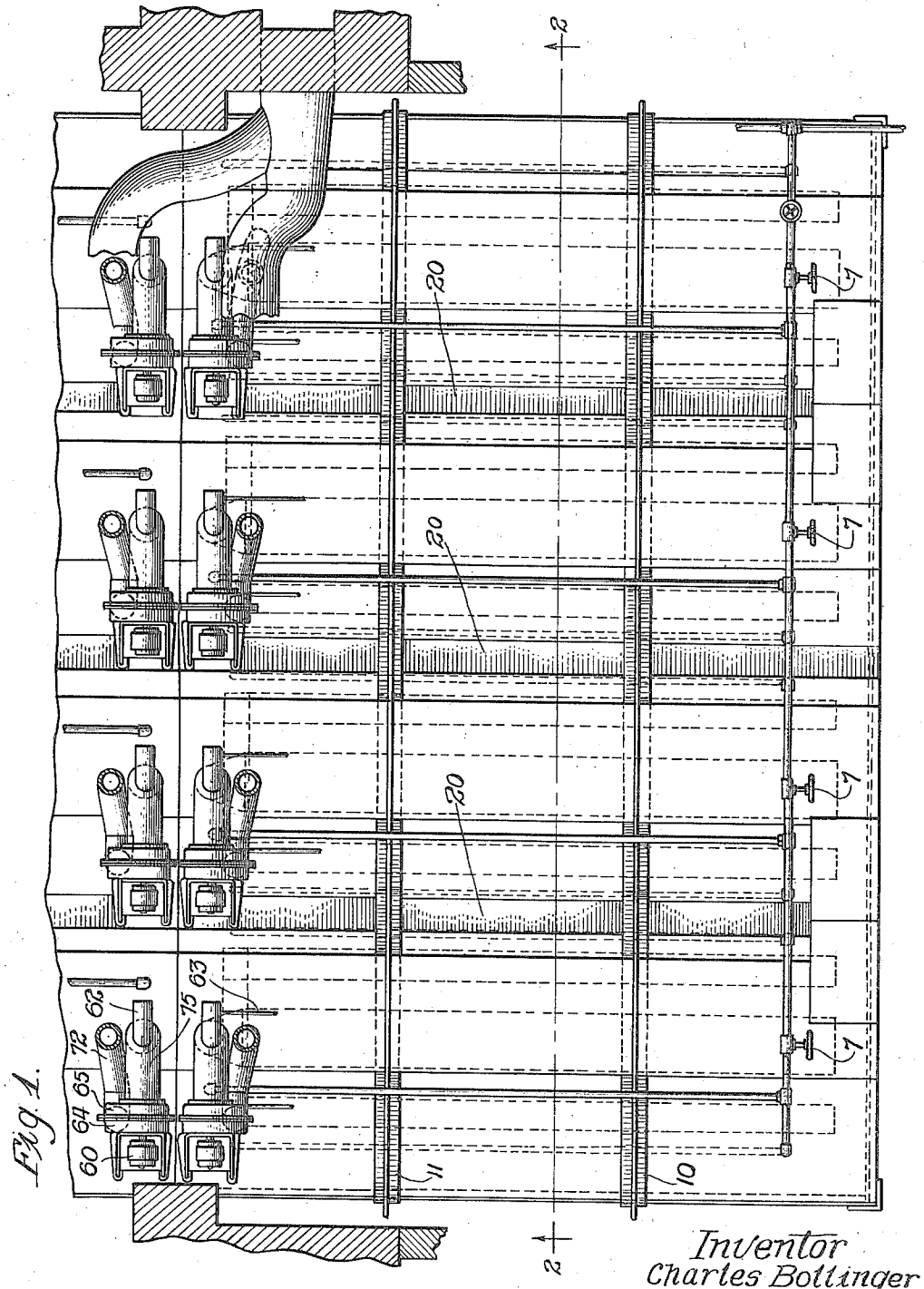


Fig. 1.

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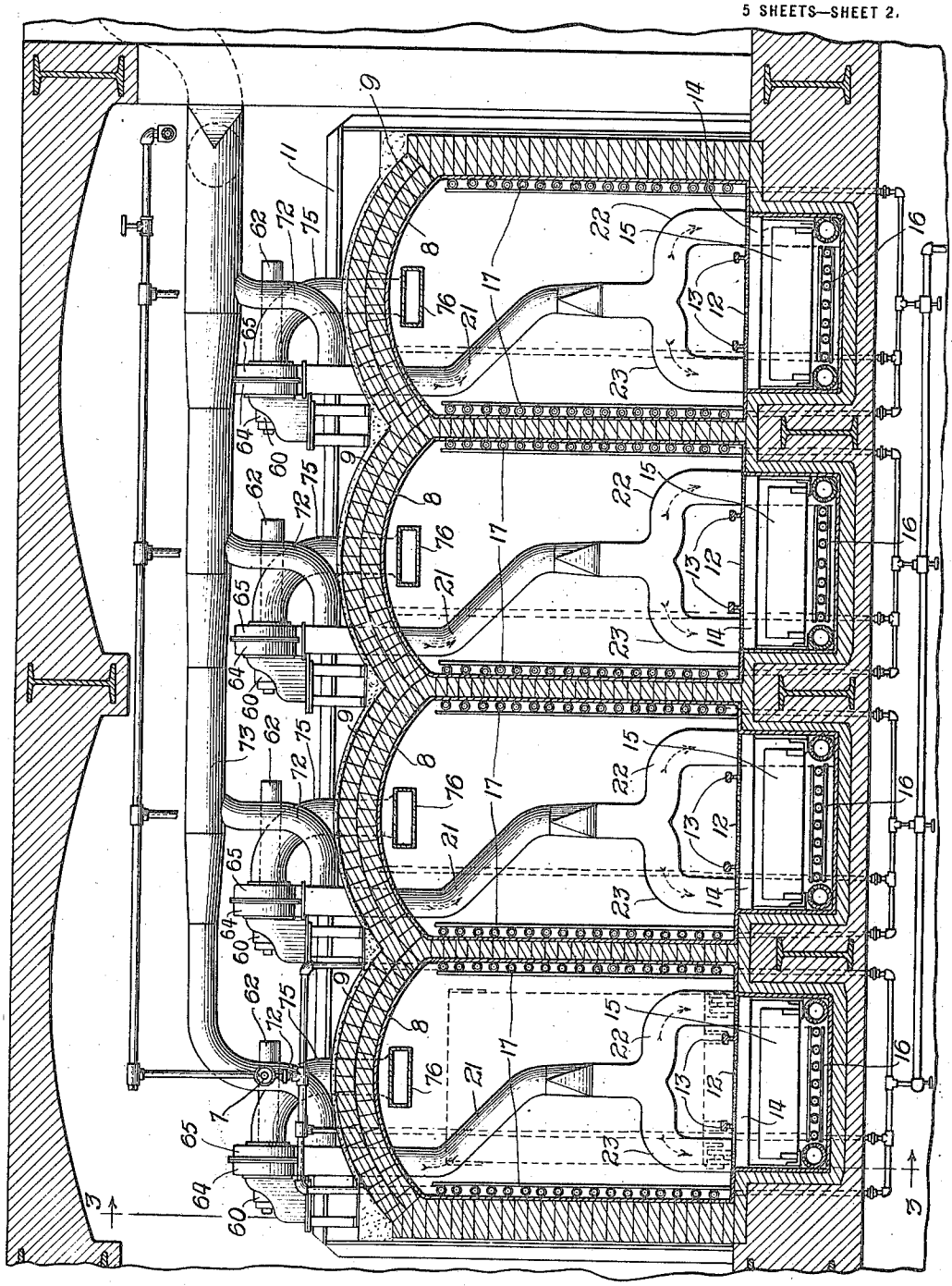


Fig. 2.

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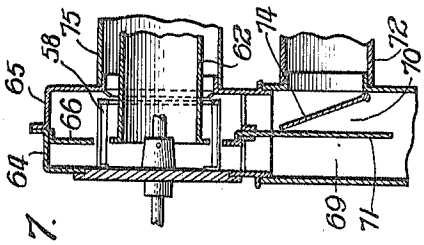


Fig. 7.

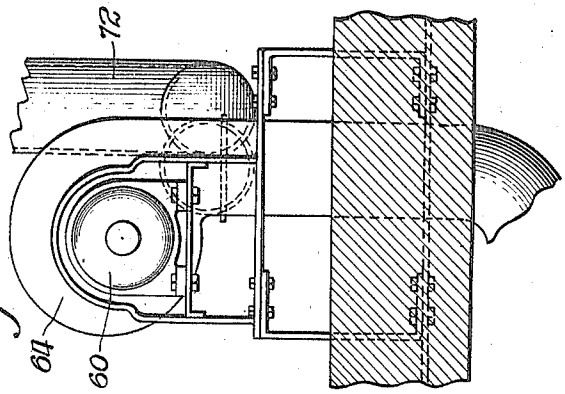


Fig. 6.

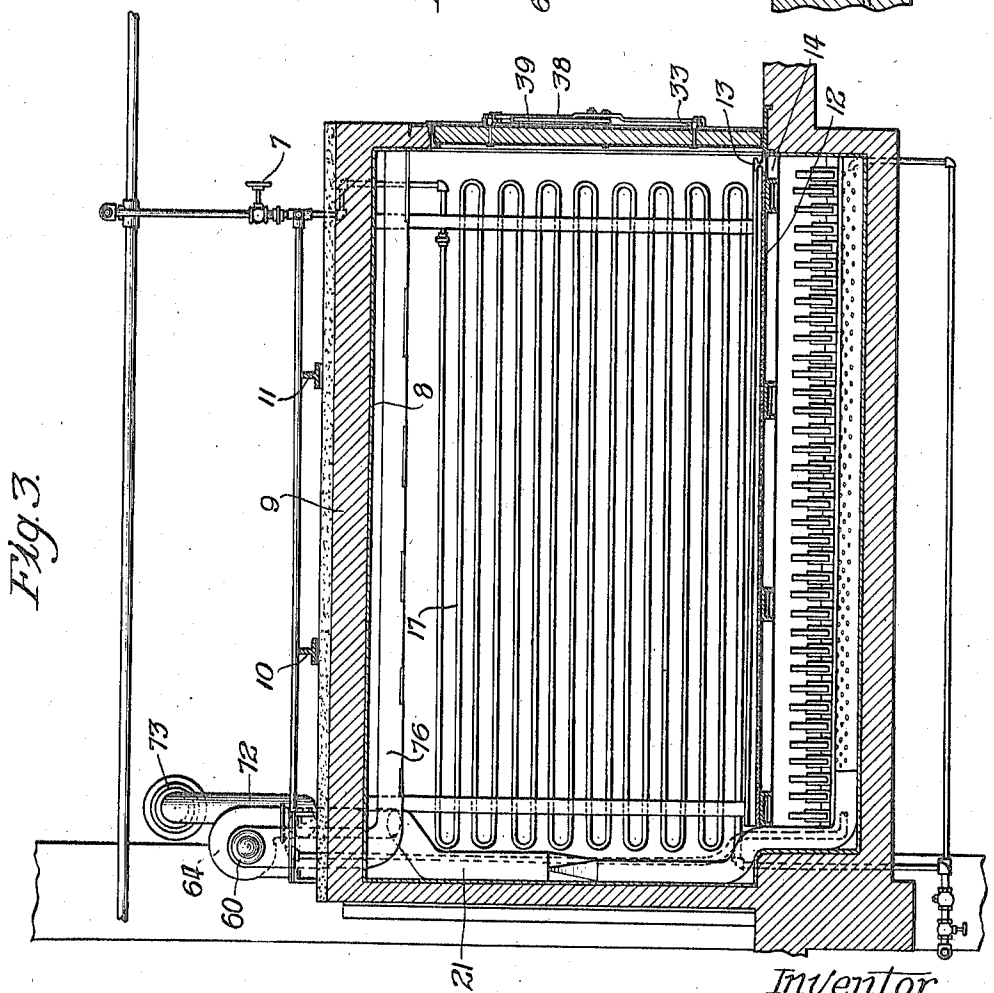


Fig. 3.

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5 SHEETS—SHEET 4.

Fig. 4.

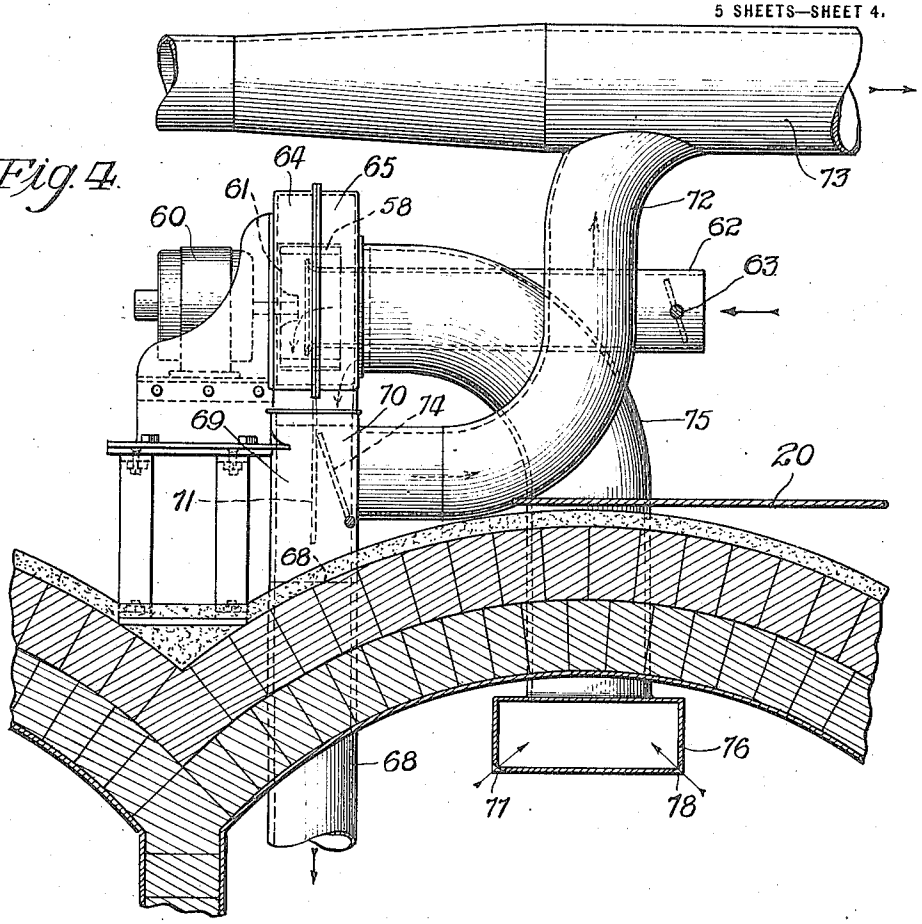
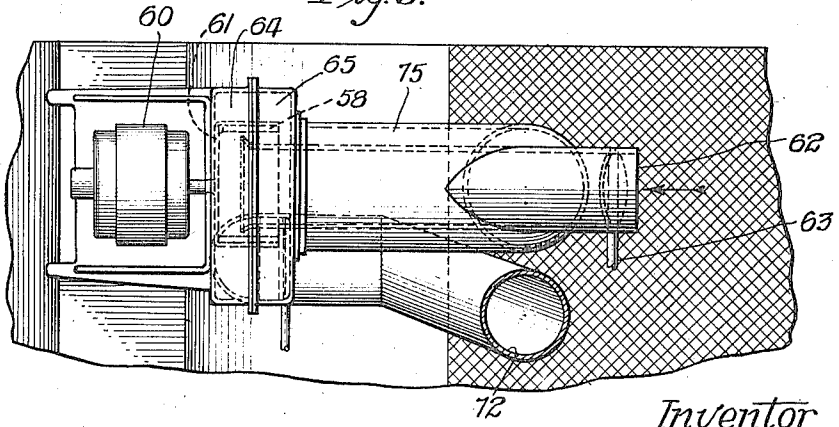


Fig. 5.



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5 SHEETS—SHEET 5.

Fig. 8.

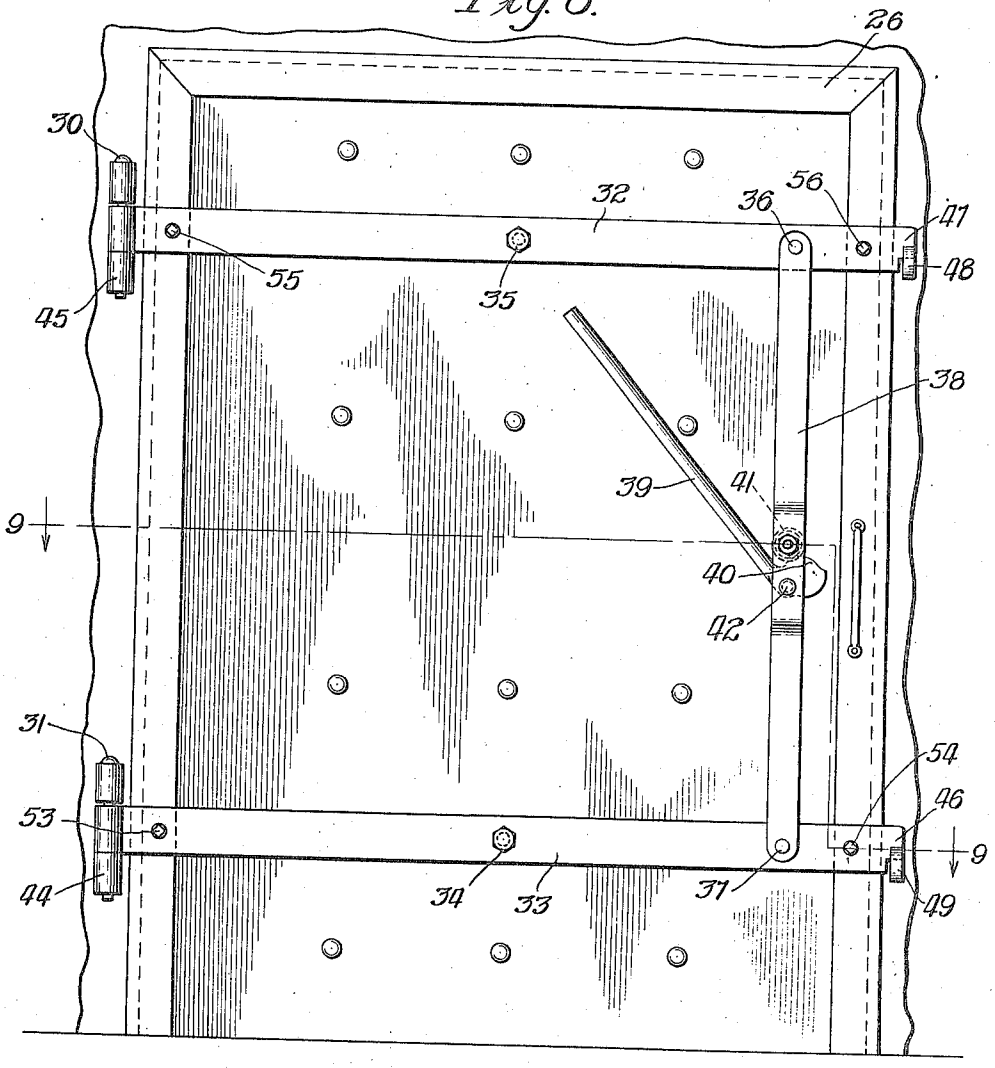
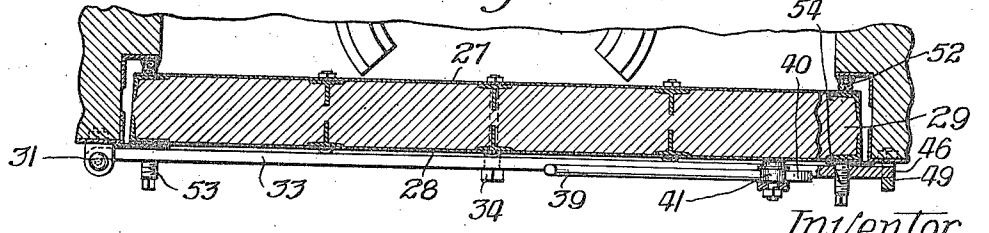


Fig. 9.



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UNITED STATES PATENT OFFICE.

CHARLES BOLLINGER, OF CHICAGO, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

RECIRCULATION SYSTEM.

1,254,650. Specification of Letters Patent. Patented Jan. 29, 1918.

Application filed August 3, 1916. Serial No. 113,012.

To all whom it may concern:

Be it known that I, CHARLES BOLLINGER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in a Recirculation System, of which the following is a full, clear, concise, and exact description.

This invention relates to a re-circulation system, and more particularly to an improved system of this type to be used with baking ovens for baking articles that have been japanned, varnished, or otherwise treated with a coating of liquid finish which requires an even baking temperature to harden into the desired coating.

One of the objects of this invention is to produce an improved, efficient, and economical recirculating system for a baking oven which will maintain an evenly distributed heat throughout the oven for a wide range of baking conditions consisting principally in variations in the size, number, and character of the articles which constitute the oven charge.

Another object is to provide an efficient and economical re-circulating system which will maintain an equal heat distribution in the oven and which can be readily adjusted to avoid fume saturation.

A further object is the production of a recirculating system out of a common exhaust system.

With these and other objects in view, the invention consists of the construction and novel combination of parts hereinafter described and pointed out in the appended claims.

The invention is illustrated in the accompanying drawings in which:

Figure 1 is a roof plan of a battery of ovens showing the external pipe connections for the re-circulating system;

Fig. 2 is a front sectional elevation on the plane 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a longitudinal section on the plane 3—3 of Fig. 2 looking in the direction of the arrows;

Fig. 4 is an enlarged front elevation partly in section of the fan and pipe connections for one of the ovens;

Fig. 5 is a plan view of Fig. 4;

Fig. 6 is an end elevation of the motor, fan, and the associated pipe connections shown in Fig. 4;

Fig. 7 shows diagrammatically the manner in which the fan and air ducts are associated;

Fig. 8 is a front elevation of one oven and illustrates the oven door and its hinge connections, and

Fig. 9 is a horizontal section on the line 9—9 of Fig. 8 looking in the direction of the arrows.

Fig. 1 illustrates the preferred form of oven construction in which the ovens are built in batteries of eight and arranged four *en-bloc*, the blocks setting back to back. Each oven is fitted with an individual fan and its associated re-circulating system. The steam and electric supply lines and also the pipe connections to the stack are common to the battery of ovens.

Each oven, as illustrated in Fig. 2, is constructed with a sheet iron lining 8 around which is placed a heat insulating brick covering 9. This structure is strengthened and reinforced by the steel bands 10 and 11 which encircle each block of ovens. The bottom of each oven consists of a removable, perforated steel plate 12 which carries a light rail track 13 upon which the trucks, carrying the parts to be baked, ride when they are inserted in the oven. The plate 12, constituting the bottom of the oven, is flush with the floor line of the room. A pit 14 is located below the plate 12 in each oven, and these pits contain the electrical heating grids 15 and the steam coils 16 which serve to heat the atmosphere in the oven. Each side of the oven is likewise equipped with a bank of steam coils 17 for heating the oven as clearly illustrated in Figs. 2 and 3. When the temperature of an oven is to be raised the steam coils serve to supply the heat necessary to rapidly raise the temperaure from room heat to 320 degrees Fahrenheit, and the electrical grids 15 are used as an auxiliary to increase the temperature beyond the possible range of steam heat. The supply of steam to the ovens is controlled by the valves 7 inserted in the steam piping at the top of the oven. The top of the oven is also

equipped with the steel runways 20 which are used to reach the fan and its associated mechanism mounted at the rear of the oven.

Each oven is equipped with an air supply duct 21 which is mounted on the rear wall of the oven and which divides into two supply pipes 22 and 23 near the floor of the oven. These supply pipes are led into the pit below the oven and are laid in the bottom of said pit below the electrical grids and extend along each edge of said pit from the rear wall to the front wall of the pit. The pipes are perforated, as shown in Fig. 3, to permit the escape of air from said pipes through the electrical grids and the perforations in the plates 12 and up through the oven. Access to the oven is obtained through the front end by means of the door 26. This door is composed of two steel plates 27 and 28 between which is placed a suitable heat insulating sheet 29. On a steel upright placed at the left of each door are mounted the butt hinges 30 and 31. These butt hinges are each equipped with the loosely mounted and elongated swinging arms 32 and 33 to which the door 26 is pivotally attached by means of the bolts 34 and 35. Secured to the arms 32 and 33 by means of the bolts 36 and 37 is the arm 38 on which is pivotally mounted the lever 39, the end of which is equipped with a cam surface 40. Mounted above the cam surface 40 and cooperating therewith is the roller 41. With the lever 39 in the position shown in Fig. 8 the door rests on the floor free from the hinges 30 and 31. However, when the lever 39 is revolved about its mounting pin 42 the cam surface 40 engages the roller 41, which is securely fastened to the door, and the door 26 is raised from the floor due to the lever action of the bars 32 and 33 swinging on the bolts 34 and 35 and bearing on the lower sleeves 44 and 45 of the hinges 31 and 30. The sleeves 44 and 45 act as fulcrums about which the levers 32 and 33 rotate, and in this rotation which is controlled by the lever 39 and its associated cam surface 40 and the roller 41 attached to the door, the door is raised from and lowered to the floor. When the door has been raised from the floor by moving the lever 39 to its alternative position, the door can freely swing on the hinges 30 and 31 and the projecting members 47 and 46 of the bars 32 and 33 will swing clear of the catches 48 and 49. By lowering the heavy door of the oven until it rests on the floor of the oven the opening between the floor and the door becomes so minute that very little, if any, of the air in the oven can escape. To further seal the connection between the door and the oven, a strip of asbestos 52, which serves as an air-tight packing, is fitted around the flanges which meet the sides and upper surface of the door when the door is swung in position. When the door is locked in position by means of the catches 48 and 49 and the arm 39, the screws 53, 54, 55, and 56 are tightened, and this serves to further seal the oven chamber.

Mounted on the top of each oven is a motor 60 which serves as the power driving means for a fan 61 of the Sirocco type. This fan consists of a plurality of paddles 58 which constitute an annular ring which may be revolved about the center line of the driving motor shaft. The fan 61 draws air from the adjoining room through the duct 62 which is equipped at its outer end with a damper 63, by means of which the amount of air drawn into the duct 62 may be regulated. The fan 61 is inclosed in a housing consisting of the two compartments 64 and 65, the compartments being divided by the partition 66 which is exterior to and surrounds the external surface of the revolving element of the fan. The end of the duct 62 is extended into the cylindrical cavity formed by the revolving element of the fan 61, and the end of said duct is fitted with a flange which is in alinement with the partition 66 and which is substantially equal in diameter to the diameter of said cavity. The fan 61 and duct 62 are so mounted that there is just sufficient clearance space between the two so that the fan may be readily revolved. Extending downward from the housing inclosing the fan is the pipe or duct 68, the upper end of which is divided into the two compartments 69 and 70, the partition 71 therebetween being in alinement with the partition 66. Feeding into the duct 68 at a position above the end of the partition 71 is the pipe or duct 72 which leads from the duct 70 into the stack 73. The duct 72 is equipped with a damper 74 at the point where its surface enters that of the duct 70, said damper being adjustably mounted so as to swing between the partition 71 and the inner surface of the duct 68. By means of this damper 74 all the air entering the compartment 70 may be either shunted through the duct 72 to the stack 73, or the duct 72 may be entirely closed, in which case the air will pass by the duct 72 and into the pipe or duct 68. By suitably adjusting the damper 74 between these two extreme positions any desired proportion of the air in the compartment 70 may be directed either through the pipe 72 or the pipe 68.

Attached to the right-hand surface of compartment 65 of the housing of the fan is a pipe or duct 75, the outer end of which terminates in a hood 76 which is located directly under the inner surface of the roof of the oven. The lower two corners of this hood 76 are equipped with slits 77 and 78 through which the air from the oven enters the hood and thence the pipe or duct 75.

The pipe or duct 75 after leaving the oven is curved at substantially right angles, and in making this curve it is fitted around the intake duct 62 which it completely incloses at the point where it enters the right-hand face of the compartment 65 of the housing of the fan. Consequently where the intake duct 62 passes into the housing 65 the duct 75 completely incloses it and the inclosing surfaces of these two ducts are in concentric relationship. The duct 68 enters the oven at the rear end thereof and continues in the duct 21 which is attached to the rear wall of the oven.

In the operation of this system the charge to be baked is inserted in the oven and the atmosphere in the oven is then raised to the desired temperature by means of the steam and electric heating elements. The circulating system is put into operation as soon as the oven is sealed.

In operating the circulating system the air from the adjoining room is drawn in through the duct 62 by the fan 61. The air drawn in through the duct 62 is forced into the compartment 64 and thence into the duct or pipe 68 which leads into the oven and connects with the pipe 21. The air is consequently forced through the pipe 21 and from there through the two branches 22 and 23 of this pipe into the perforated tubes in the bottom of the pit. The air on entering these tubes escapes through the perforations and up through the electrical heating grids and the perforations in the floor 12 into the oven, from where it rises to the roof of the oven in which passage it comes into contact with the parts which have been placed in the oven to be baked. The air on reaching the roof of the oven is drawn through the slits 77 and 78 into the hood 76 and thence into the exhaust pipe 75 by that portion of the fan 61 which extends to the right of the partition 66. The air is drawn from the tube 75 into the compartment 65 and from there it is forced either into the pipe 72 from where it escapes into the stack pipe 73 or back into the tube 68, depending upon the position of the damper 74. The path which the air follows in circulating through the pipes is indicated by the arrows in Fig. 4.

It will be obvious that the dampers 63 and 74 can be adjusted so as to regulate the heat and pressure of the air within the oven chamber. Thus if the damper 63 is completely closed and the damper 74 moved to the right so as to close the opening into the pipe 72, no fresh air will be drawn into the system and the air in the oven will be repeatedly exhausted and re-circulated. Likewise if the damper 74 is thrown to its extreme left position and the damper 63 is open, none of the air exhausted from the oven will be re-circulated, and fresh air from the room will be continually forced into the oven. It consequently follows that the dampers 63 and 74 may be readily adjusted so that the atmosphere in the oven may be maintained at any desired temperature and pressure and also that the fumes generated as a result of the baking process may be exhausted and expelled from the oven at any desired rate. The fan 61 in effect functions as two independent units, the left portion of the fan, which is connected with the compartment 69 and the duct 62, serving to force fresh air into the oven, and the right portion of the fan, connecting with the chamber 70 and the duct 75, serving to exhaust the fume laden air from the oven and to then either exhaust said air into the stack 73 or re-circulate it through the oven. That portion of the fan inclosed in the compartment 64 therefore acts as a pressure unit, and that part of the fan inclosed in the chamber 65 acts either as a re-circulating or an exhausting unit or both, depending upon the setting of the damper 74.

Experience has demonstrated that in order to obtain the best results in the baking of articles with an oven of this type, the oven should be operated under pressure. This pressure operation is readily obtained by a proper setting of the various dampers. Thus with the damper 63 open and the damper 74 moved to the right so as to close the duct 72, the air in the oven will be continually re-circulated by the right section of the fan, and fresh air will be forced into the oven by the left section of the fan, thereby putting the atmosphere in the oven under the maximum pressure. Suitable reductions from this maximum oven pressure are readily obtainable by proper adjustments or settings of the dampers 63 and 74. The use of a re-circulating system of this type effects a considerable economy since the air within the oven chamber which has been heated is readily re-circulated through the system and only that amount of cold air which is required to prevent fume saturation need be drawn from the outer room into the system.

When the articles which are to be baked in an oven vary considerably in size and quantity, the temperature and amount of circulation required in the oven to obtain a satisfactory finish must be changed with each alteration in the oven charge. The oven and re-circulating system herein described is especially well adapted where the articles to be baked constantly vary from large to very small articles. Although this invention has been described and illustrated in connection with a baking oven, obviously it is not limited to this preferred embodiment, but is capable of many variations and applications without departing from its spirit and scope.

What is claimed is:

1. In a re-circulating system, the combina-

tion with a fan comprising two units, of a duct for supplying air connected to one of said units, means into which said air is forced by said fan unit, a duct interconnecting said means and said other fan unit whereby the air is drawn from said means, and means interconnecting said first-mentioned means and said second unit for re-circulating said air.

2. In a re-circulating system, the combination with a fan comprising two units, of a duct for supplying air connected with one of said units, means for regulating the amount of air drawn into said duct, a chamber into which said air is forced by said fan unit, a duct interconnecting said chamber and said other fan unit whereby air is drawn from said chamber, a second duct interconnecting said chamber and said second unit whereby the air in said chamber may be re-circulated, an exhaust duct connected to said second duct, and adjusting means whereby the air from said chamber may be re-circulated through said chamber or exhausted into said exhaust duct.

3. In a re-circulating system, in combination, a fan comprising two units, an air duct connected and individual to one of said units, a second air duct connected and individual to the other of said units, a third air duct common to both of said units, means interconnecting said second and third ducts, and means to regulate the air currents in said ducts whereby an atmospheric pressure is produced in said first-mentioned means.

4. In a re-circulating system, in combination, a fan comprising two units, an air duct connected and individual to one of said units, a second air duct connected and individual to the other of said units, a third air duct common to both of said units, a heating chamber interconnecting said second and third ducts, means associated with said first-mentioned duct to regulate the air drawn into said chamber by said first fan unit, an air exhausting duct, and means associated with said exhausting duct to regulate the amount of air exhausted or re-circulated by said second fan unit.

5. In a re-circulating system, the combination with a fan, of an air duct for supplying air to said fan, said air duct extending into and being inclosed by said fan and terminating substantially midway between the vertical faces of said fan, an air conveying means to receive air from said fan, an inclosure to which the air is conveyed from said means, means to convey the air from said inclosure to said fan, said means inclosing the supply duct as it enters the fan and terminating at a vertical face of said fan, and means whereby the air in said last-mentioned means may be re-circulated through said inclosure.

6. In a re-circulating system, the combination with a fan, of an air duct for supplying air to said fan, said duct extending into and being inclosed by said fan and terminating substantially midway between the vertical faces of said fan, an air conveying means to receive air from said fan, an inclosure to which the air is conveyed from said means, means to convey the air from said inclosure to said fan, said means inclosing the supply duct as it enters the fan and terminating at a vertical face of said fan, means to receive the air from said last-mentioned means and from which it may be re-circulated by said fan, and adjusting means to regulate the amount of air in the receiving means that is to be re-circulated.

7. In a re-circulating system, the combination of an oven, means to heat the air in said oven, an intake air duct terminating at the base of said oven, an exhaust air duct terminating in the oven chamber near the roof of said oven, a fan, an inclosure for said fan, means dividing said inclosure into two substantially equal compartments said intake air duct connecting with said two compartments, a fresh air supply duct for said fan extending just beyond said means and conducting air into one of said compartments, said exhaust duct connecting with the other compartment of said inclosure and completely inclosing the supply air duct where it enters the inclosure, a stack exhaust pipe connected with said other compartment, and means to regulate the supply of fresh air to said oven.

8. In a re-circulating system in combination, a fan, an inclosure for said fan, a partition dividing said inclosure in two substantially equal compartments, a fresh air intake pipe for said fan located inside the annular ring comprising the fan blades and terminating in one of said compartments, an oven, a conducting pipe interconnecting said compartments and said oven, an exhaust pipe interconnecting said oven and said other compartment and completely inclosing said fresh air intake pipe where it enters said inclosure, a stack pipe connected to said other compartment, means associated with said intake to control the fresh air supply, and means associated with said stack pipe to control the amount of oven air re-circulated whereby the temperature and state of saturation of the air in said oven may be regulated.

In witness whereof, I hereunto subscribe my name this 27th day of July, A. D. 1916.

CHARLES BOLLINGER.