J. E. KENNEDY.

KILN.

APPLICATION FILED APR. 2, 1907.

911,658.

Patented Feb. 9, 1909.

3 SHEETS—SHEET 1.

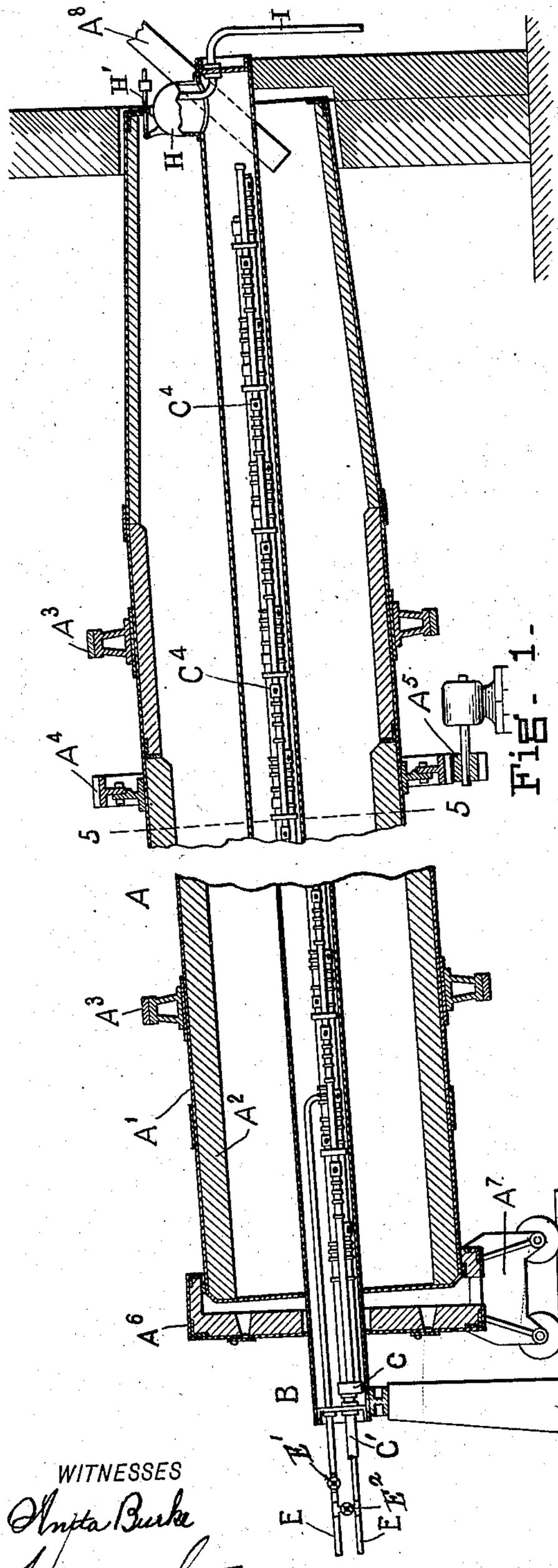

Fig. 1.

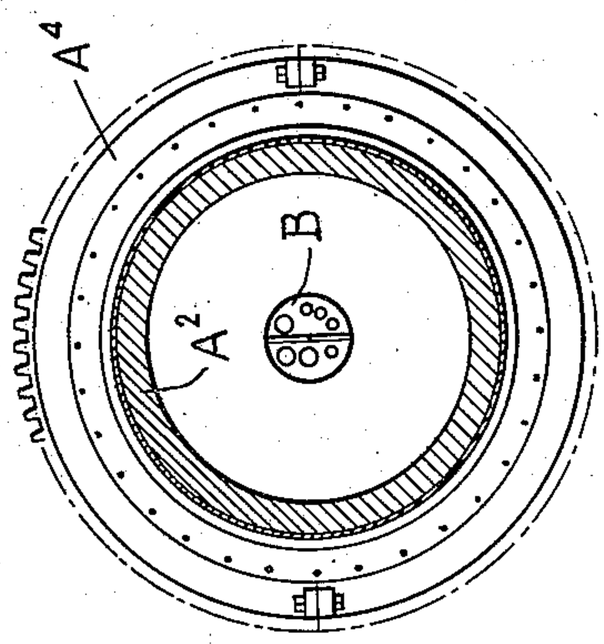

Fig. 5.

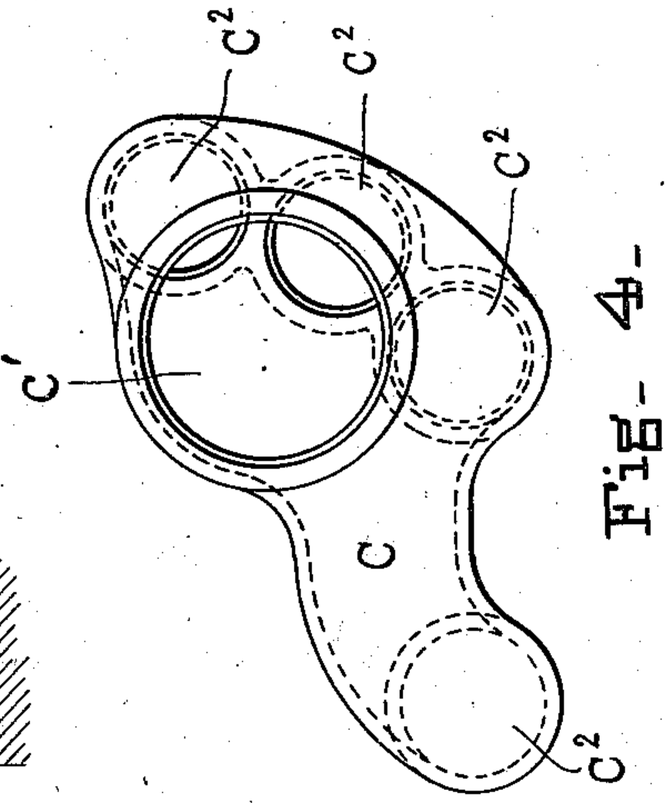

Fig. 4.

WITNESSES

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3 SHEETS—SHEET 2.

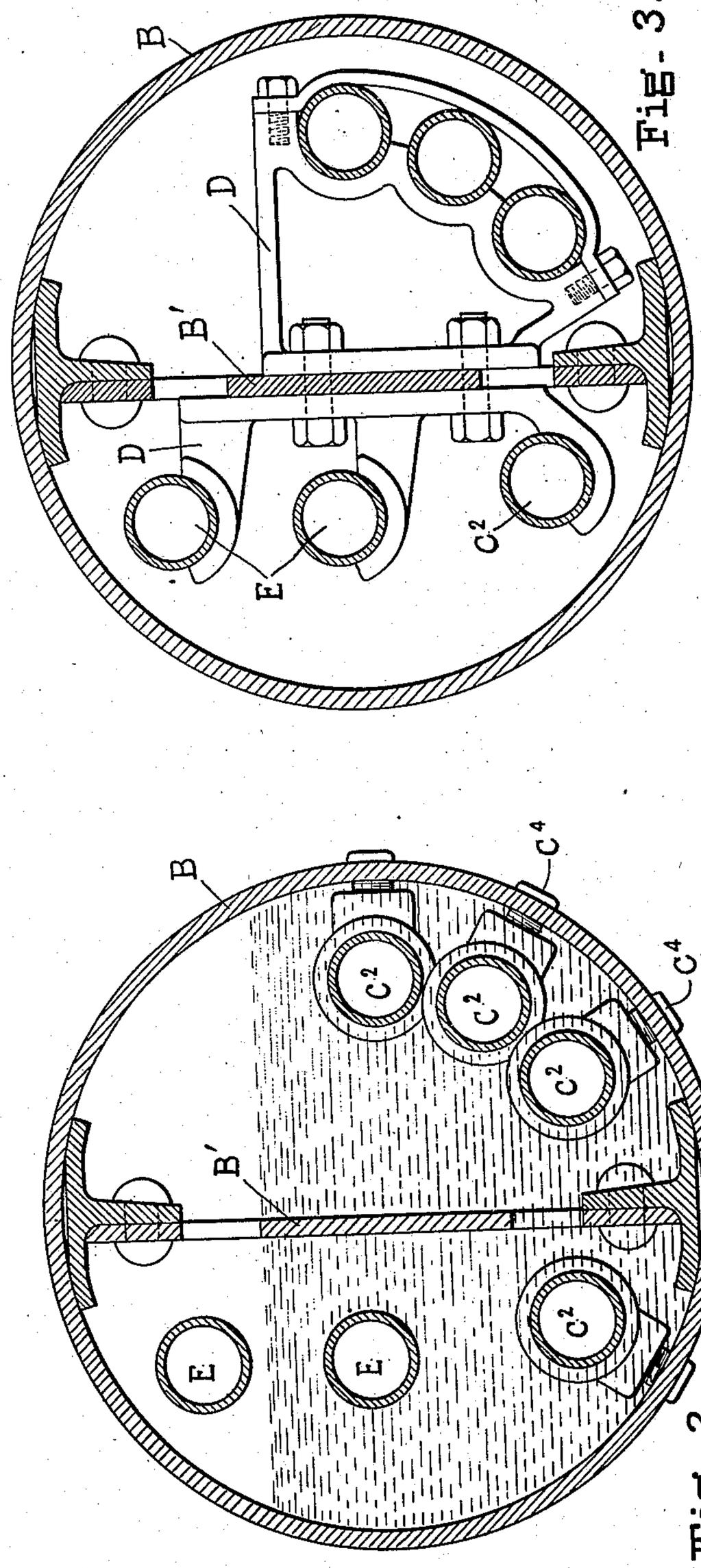

Fig. 3.

Fig. 2.

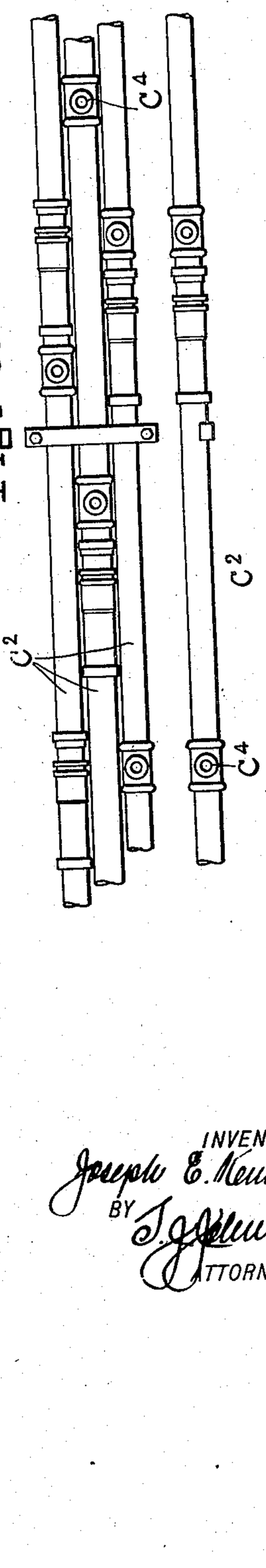

Fig. 6.

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3 SHEETS—SHEET 3.

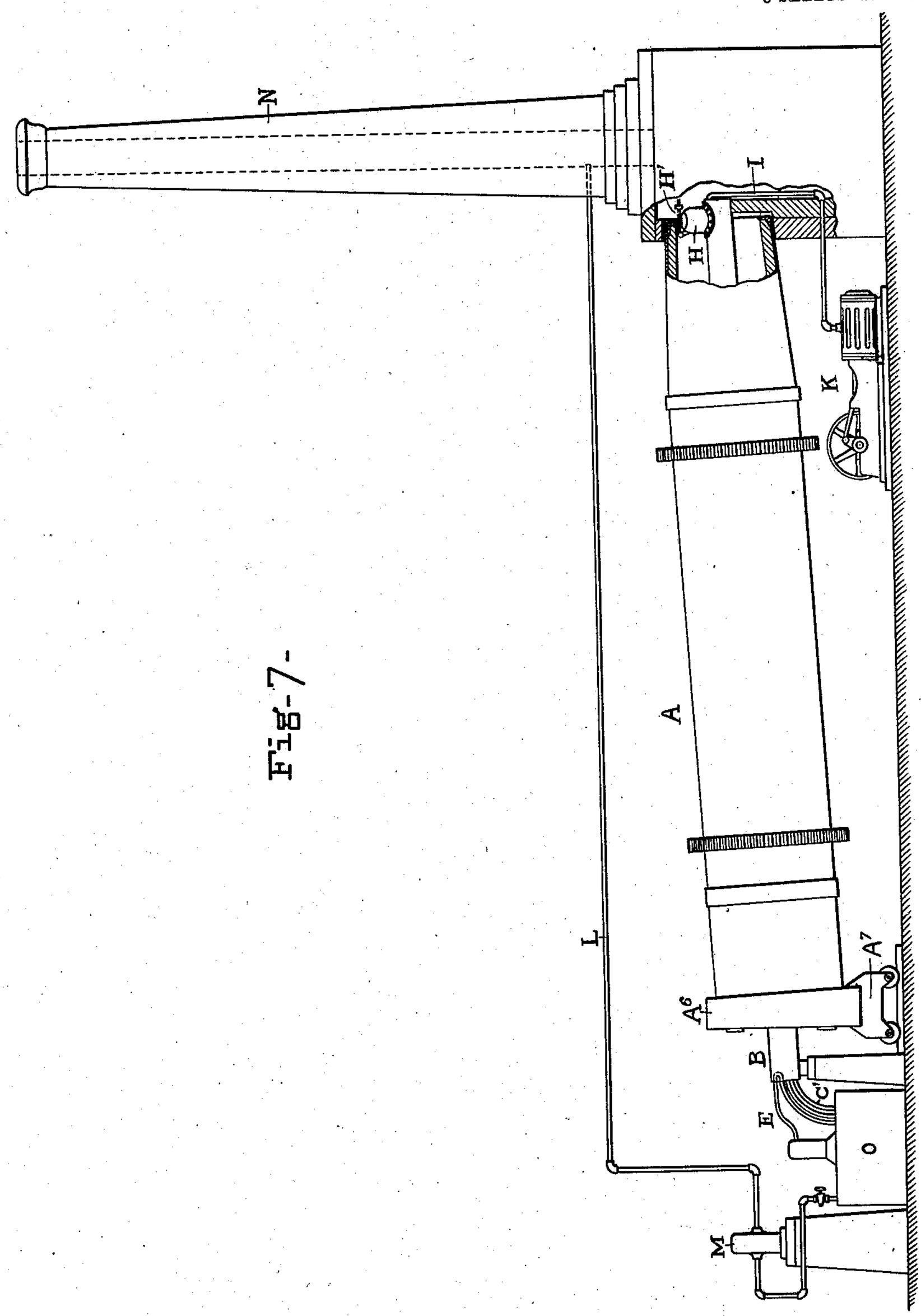

Fig-7-

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UNITED STATES PATENT OFFICE.

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KILN.

No. 911,658. Specification of Letters Patent. Patented Feb. 9, 1909.

Application filed April 2, 1907. Serial No. 365,936.

To all whom it may concern:

Be it known that I, JOSEPH E. KENNEDY, a citizen of the United States, residing in New York city, in the State of New York, have made certain new and useful Improvements in Kilns, of which the following is a specification.

My present invention relates to the calcination of lime, the clinkering of cement, etc., although it is applicable also to other analogous purposes.

It consists in an apparatus designed to effect combustion of the heat-producing agent throughout the whole extent of the kiln, as distinct from those forms of calcining apparatus which operate by producing a fire locally and distributing in one way or other the heat generated at the fire through the rock to be calcined.

Kilns of the class last referred to have been in use for many hundred years and are well adapted to their purpose for small outputs, and with certain restrictions as to the character of fuel to be used. In general this has been wood; and it is only in recent years that improvements have been made in construction, which permit lime-burning by means of coal, and then only by special apparatus and appliances expensive to install and to keep in order. Attempts have also been made to calcine lime by means of producer gas or natural gas, which have not, so far as I am aware, been attended with any marked success. In general, the idea of these devices has been to burn a mixture of gas and air in a restricted zone of a suitable kiln, the flame directed upon the stone to be calcined; but these attempts have in many cases resulted in making an inferior quality of lime, because the particles would be subjected to such heat that the silica in them would fuse or vitrify, and the lime carbonate would be soluble in water only with great difficulty and after a considerable time, since the water must penetrate the pellicle of silica before it can attack the lime. Lime in this condition may remain in the mortar or plaster for months before the water finally attacks it, and if it then slakes in the wall it pits or "pops" the mortar or plaster. Such lime is only merchantable in small quantities and at a low price.

For a number of reasons it is desirable that the kiln in which the lime is burned shall be long, since this subjects the materials fed in at the top to heat for a considerable time, and they thus absorb the heat from the waste gases as these pass towards the atmosphere. With a kiln of the ordinary kind, however, it is obvious that the best temperature for calcination is localized in a zone of greater or less width at some part of the kiln; the parts of the latter, nearer the fire than this zone, having too high a heat for the best results, and those further away being too cool to dissociate the oxygen from the calcium carbonate.

It is therefore one of the objects of my invention to distribute the localities of combustion, if necessary, throughout substantially the entire length of the kiln, which may be as long as is mechanically expedient, and to maintain in these localities substantially uniform temperatures, selected to effect the proper calcination of the particular rock supplied to the kiln. Thus the entire combustion chamber of the kiln being at nearly the same temperature, the product will be even and of uniform quality.

To effect the purposes of my invention I have devised the apparatus which is illustrated in the accompanying drawings. Briefly described, these show a rotary kiln having in the axis thereof a water-cooled manifold, to supply a mixture of gas and air, or gas, air, and waste gases from the stack, to the interior of the kiln through burners which are distributed throughout its entire length and circumference, or so much thereof as may be desired; so that when the gas and air under pressure are forced into the combustion chamber there is a uniform flame of such a low or moderate absolute temperature as not to vitrify the lime, but of such high temperature relatively as to effectively calcine it. The kiln of course may be constructed in any desirable manner, though in general for accuracy of manufacture I prefer to make it of a boiler shell of iron or steel, lined with suitable refractory material, preferably basic, such for instance as magnesite brick; although some forms of good fire-brick are also well adapted for the purpose.

With the arrangement described, it is desirable in order to maintain the temperature at substantially the proper point at all seasons of the year to provide for changing the temperature of the air supply as may be desired. For this purpose, I arrange in the jacket of the manifold a pipe through which the air may be blown to the mixing chamber,

or which may be closed as desired. The temperature of the air-supply may thus be maintained constant, if expedient, or may be made higher in cold weather to compensate for the increased heat-loss due to the chilling of the supplied material. Also I prefer to so arrange a pipe that gases from the stack may be mixed with the gas and air forming the fuel supply for the kiln, so as to reduce the temperature at which combustion takes place to such an extent as may be necessary to get the best results with the material to be calcined or clinkered. This may be accomplished in a number of different ways.

Since the heat of combustion is very intense, obviously the water in the jacket will be raised to a high temperature and unless the circulation is considerable will make steam, which may be used for any purpose desired. To provide for this, I combine with the water-jacket a steam dome of approved construction which should preferably be near the stack so as to derive as much of the superheat as possible from the waste gases.

Figure 1 is a longitudinal vertical section partly broken away of a kiln constructed according to my invention. Figs. 2 and 3 are cross-sections of the manifold and its jacket, showing two different ways of supporting the pipes. Fig. 4 is the header for the manifold, shown in elevation. Fig. 5 is a section on the line 5—5 of the kiln shown in Fig. 1. Fig. 6 is a detail in plan of the manifold. Fig. 7 is a diagrammatic sketch of the general arrangement of a plant embodying my invention.

In Fig. 1, A is the kiln, composed of a shell A^1 of boiler iron and having a refractory lining A^2, which may be composed of any heat-resisting material not readily attacked by the reactions inherent in lime reduction, such as magnesite brick. Any suitable or usual methods of lining may be adopted. The weight of the kiln is supported upon ordinary roller-bearings, not illustrated, it being carried by the rings A^3 A^3. A^4 is a gear driven by a motor, shown conventionally at A^5. A^6 is the end-wall of the kiln constructed substantially in the same manner as the body; this end-wall is carried upon a truck A^7, by which it may be rolled away when repairs are desired, thus giving access to the interior of the kiln. A^8 is a deflecting plate by which the charge may be run into the kiln. B is the jacket of the manifold, which is composed of a shell of boiler-iron and is provided with an internal truss B^1 (see Figs. 2 and 3); within the manifold are arranged the pipes C^2 for the mixture of gas and air, outlet nipples C^4 being provided by which the gas may be passed through the water-jacket. These are illustrated conventionally in Fig. 1, and are shown more correctly and upon a larger scale in Fig. 2. The outlets are arranged symmetrically throughout the length of the water-jacket, so that their distribution of gas and air may be substantially uniform throughout the entire combustion chamber of the kiln. The manifold is supplied from a main pipe C^1 which passes through the header C. The pipe E is arranged so that a portion of its length is in the interior of the kiln, preferably inside of the water-cooled shell which holds the manifold; a bypass outside of the shell is provided, and valves E^1 E^2; by opening the valve E^1 and closing E^2, the air which is blown through the pipe (by any suitable apparatus not illustrated) passes through a part of it inside the kiln and becomes heated before being carried to a mixing chamber, (shown in Fig. 7); by closing valve E^1 and opening E^2, the air may be run through at natural temperature. The water-supply pipes are not illustrated, since their construction is well understood. At H is shown a steam dome of approved construction, provided with a safety valve H^1; this dome should be located near the stack so as to derive the superheat as far as possible from the waste gases after they have performed their office of calcination or clinkering. A pipe I, leads the steam (see Fig. 7) to an engine K, for which, of course any other form of utilization may be substituted.

Referring again to Figs. 2 and 3, as illustrated in Fig. 2 the manifold is supported in place by the nipples C^4, which pass through the walls in the water-jacket; but in Fig. 3 a rack D is provided which carries all the pipes referred to, the rack being attached to the center partition or truss of the water-jacket.

In Fig. 4 the header for the manifold is shown, C^1 being the opening for the pipe from the mixing chamber, and C^3 C^2 being the ends of the pipes delivering the gas supply to the kiln.

In Fig. 5 is shown a section upon the line 5—5 of Fig. 1, the parts of which require no detailed description; while Fig. 6 shows the arrangement of the pipes, the nipples C^4 upon which are longitudinally displaced from one another to effect the thorough distribution of the gas supply throughout the body of the kiln.

Referring now to Fig. 7, the general arrangement of the plant is shown. Here the pipe L extends from the stack to a fan M which may be driven by any suitable source of power. The office of this pipe and fan is as already indicated to supply a portion of the stack gases directly to the mixing chamber O, from which the supply of gas and air is carried into the manifold; the waste gases may be blown directly into the kiln, if desired, and there mix with the fuel gas. By suitable regulation of the temperature of the air and the mixture of the products of combustion with the fuel-supply, a precise adaptation of the flame of the kiln to the require-

ments of the particular material to be treated may be reached, and the best results attained.

Having thus described my invention, what I claim and desire to protect by Letters-Patent of the United States is:

1. The combination, with the kiln, means for rotating the kiln, and a source of supply of gas and air, of a water-cooled pipe or manifold connected to such source and receiving therefrom the mixture of gas and air extending substantially through the axis of the kiln, the manifold provided with outlets disposed with substantial symmetry in the kiln; so that the supply of gas and air is substantially equal throughout the combustion chamber of the kiln.

2. The combination, with a rotary kiln, of a water-jacket disposed substantially in the axis thereof and provided with a truss for preventing deformation, and a manifold for gas and air arranged within the water-jacket, and having outlets passing through the walls thereof, substantially symmetrically disposed within the kiln.

3. The combination, with a rotary kiln having a gas-supply pipe provided with a surrounding water-jacket; of a pipe for the air supply, also disposed within the water-jacket.

4. The combination, with a rotary kiln, a water-cooled manifold disposed substantially in the axis of extending approximately throughout the length of the kiln, and a source of gas and air supplying the manifold, the manifold having outlets symmetrically disposed in the kiln so as to distribute a mixture of gas and air to all parts thereof with substantial equality, of means for supplying a part of the stack-gases to the kiln.

5. The combination, with a rotary kiln and a water-cooled manifold therein forming the fuel-supply, of a mixing chamber connected with the manifold, gas-supply and air-supply pipes connected to the mixing chamber, and means for supplying to the mixing chamber a part of the stack gases.

6. The combination, with a horizontal rotary kiln, of a water-cooled manifold forming the fuel-supply therefor, a mixing chamber connected with the manifold, means for supplying gas and air to the mixing chamber, and means for regulating the temperature of the air-supply.

7. The combination, with a rotary kiln, having a pipe passing therethrough and forming a fuel-supply, of a water-jacket for the pipe, and a steam-chamber upon the water-jacket.

8. The combination, with a rotary kiln, of pipes forming the fuel-supply disposed within the kiln; a water-jacket for the pipes, and a steam dome or chamber upon the water-jacket, disposed at or about the stack end of the kiln.

In witness whereof I have hereunto set my name in the presence of two witnesses.

JOSEPH E. KENNEDY.

Witnesses:
IRVING M. OBRIEGHT,
T. J. JOHNSTON.