

H. C. L. GOUGNARD.
ELECTROLYZING APPARATUS.
APPLICATION FILED SEPT. 4, 1913.

1,273,357.

Patented July 23, 1918.

3 SHEETS—SHEET 1.

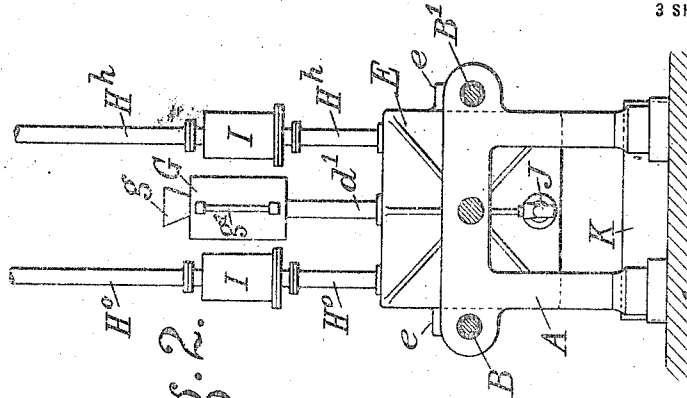


Fig. 2.

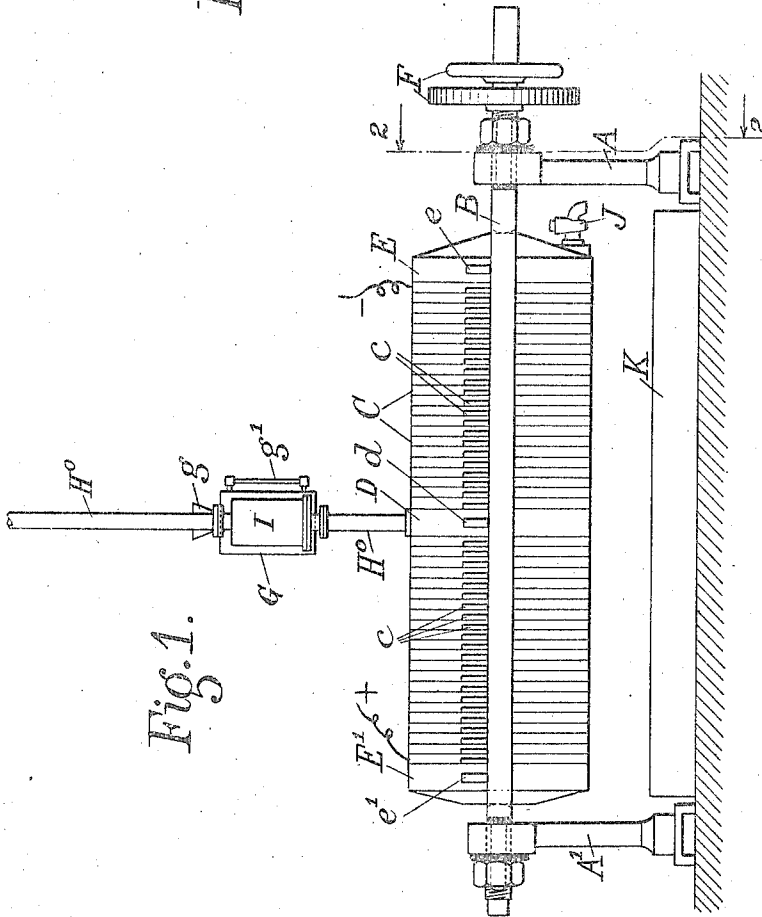


Fig. 1.

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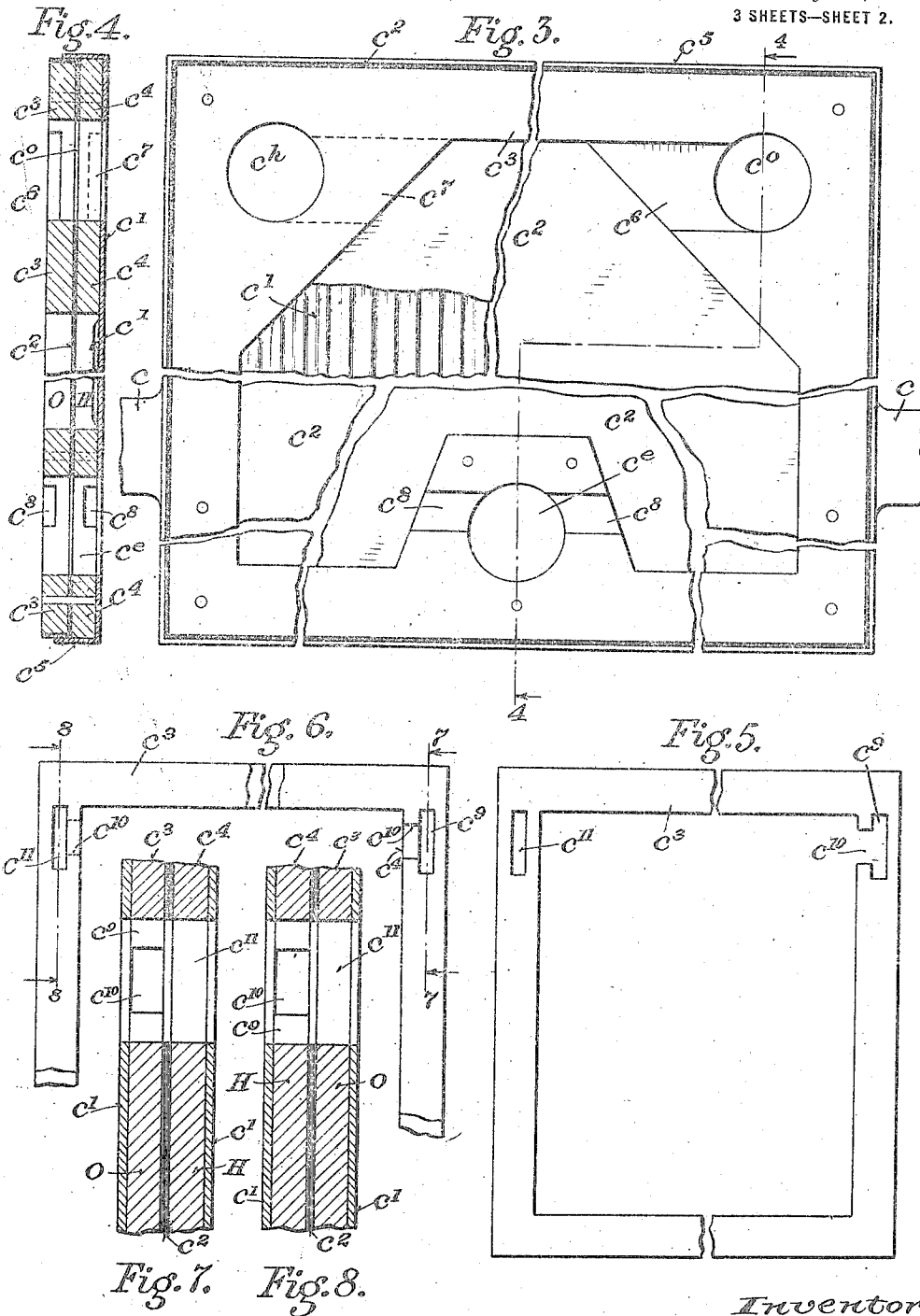
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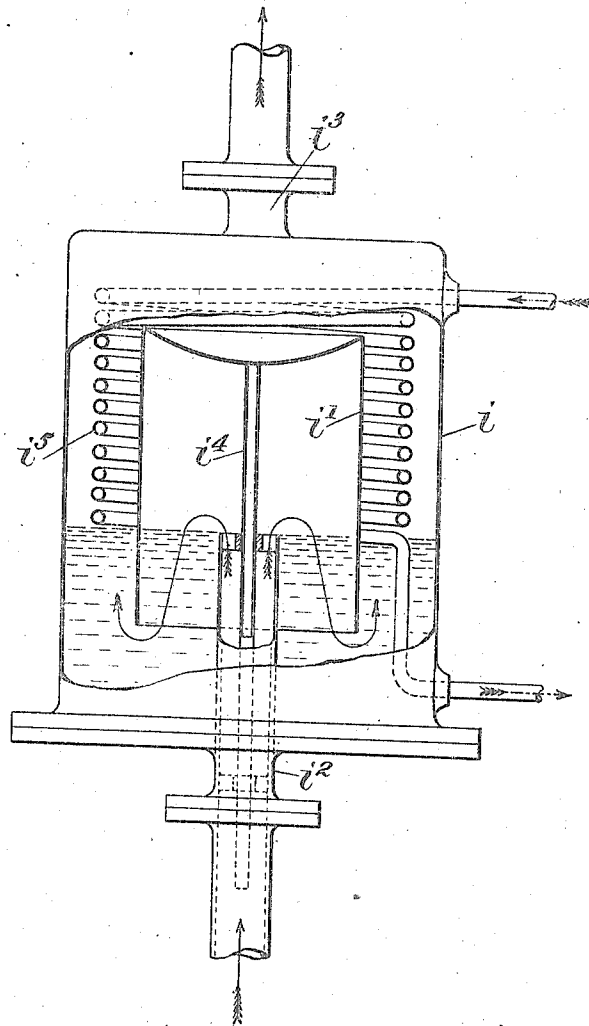
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3 SHEETS—SHEET 3.

Fig. 9.



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UNITED STATES PATENT OFFICE.

HENRI CLÉMENT LAMBERT GOUGNARD, OF PARIS, FRANCE, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE LINDE AIR PRODUCTS COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

ELECTROLYZING APPARATUS.

1,273,357.

Specification of Letters Patent.

Patented July 23, 1918.

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To all whom it may concern:

Be it known that I, HENRI CLÉMENT LAMBERT GOUGNARD, engineer, a subject of the Kingdom of Belgium, residing at Paris, in the country of France, have invented new and useful Improvements in Electrolyzing Apparatus, of which the following is a specification.

The present invention relates to an electrolyzing apparatus for obtaining oxygen and hydrogen on a commercial scale by the electrolysis of water.

The main objects of the invention are to facilitate assembling and taking apart the elements or members of the apparatus; to produce and maintain tight joints between the elements without special or extra packing; to avoid or reduce the danger incident to explosions; and generally to reduce the weight and cost, prolong the life and improve the construction and operation of apparatus of this class.

The accompanying drawings show, by way of example, an electrolyzer constructed according to my invention.

Figure 1 is a general view of the apparatus, in elevation;

Fig. 2 is an end view, representing a section on line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a front elevation on a larger scale of an element of the electrolyzer in Fig. 1, the element being shown broken into several pieces in order to save space.

Fig. 4 is a section along line 4—4, of Fig. 3 looking in the direction of the arrows.

Figs. 5, 6, 7 and 8 show a different arrangement of the frames constituting each element of the electrolyzer; Fig. 5 is a front view of a frame, broken in order to save space; Fig. 6 is a front elevation of two portions of frames, similar to that of Fig. 5, placed one upon the other; Figs. 7 and 8, are sections on a larger scale along lines 7—7 and 8—8 respectively in Fig. 6, looking in the direction of the arrows, with asbestos diaphragm between the frames and electrodes on each side of the frames.

Fig. 9 is a detail, partly broken open and partly in vertical section of one of the pressure regulators which are combined with the electrolyzer.

The electrolyzing apparatus consists essentially (Figs. 1 and 2) of a framework comprising two end cheeks or standards A, A', 55 connected by two longitudinal parallel rods, B, B', which are insulated from them. The elements C of the electrolyzer (which are described later) are supported on the rods by means of lugs c. These elements C are 60 mounted in the same way as those of a filter-press and are clamped between a central plate or head D and two end-plates E, E', by a clamping device F of any suitable known type. The plates D, E, E', are also supported 65 on the rods B, B' by means of lugs d, e, e' (Fig. 1).

The electric current enters the apparatus at one end by one of the end elements, and leaves it at the other end by the other end 70 element. Each element constitutes a bipolar electrode, one side of which acts as anode while the other plays the part of a cathode, in the known manner.

The central plate D is formed with an electrolyte chamber and gas openings or passages 75 corresponding with those of the several elements and a reservoir G, provided with a filling funnel g and a gage glass g', by means of which the liquid level in the electrolyzer can be kept constant, is connected 80 to this chamber by a pipe d'.

The liquid employed as electrolyte is preferably a solution of caustic potash or caustic soda at 25° Baumé. 85

H^o represents the outlet pipe for one of the gases; oxygen for example, and H^h the outlet pipe for the hydrogen. A pressure regulator I is inserted in each of these pipes and will be hereinafter described in detail. 90 These regulators I, besides serving to regulate the pressure of the gases produced, prevent mud from rising any higher in the pipe line; they also insure safety by preventing any return of flame into the electrolyzer in 95 case of accident in the pipe line.

Below the apparatus, which is provided with a discharge cock J (Fig. 1), is arranged a sheet metal vessel K, to receive any drops of the electrolytic liquid which might leak 100 through the joints between the different elements of the electrolyzer.

Each of the elements C of the apparatus consists essentially (see Figs. 3 and 4), of

an iron electrode c' of slight thickness (a thickness of 2 mm. has been found in practice to give good results), and of a diaphragm c^2 , consisting of a sheet of asbestos which is cut directly out of the sheet without any hem, and is held between the two frames c^3 , c^4 , of wood, ebonite, vulcanite, compressed cork or any other suitable insulating material. The two frames c^3 and c^4 and the diaphragm c^2 are attached to each other, for example, by means of pins of wood or other suitable material, and the whole is inserted in the electrode c' , which is provided for this purpose along its entire circumference with a bent up flange c^5 , and is also provided with supporting lugs c which have already been referred to. The electrode c' is bi-polar, that is to say it forms the anode on one of its faces and the cathode on the other, as has been mentioned above. The surfaces of this electrode are corrugated, embossed, or formed in some other manner such as will present an undulatory or extended active surface and one of the faces, the anode face, may be nickerled.

The whole thus constituted forms a very rigid and a very light element.

c^6 is a conduit formed by registering openings in the frames, the diaphragm and the electrodes for one of the gases, oxygen for example, and c^7 is a similar conduit for the hydrogen. A groove or passage c^8 , equal in depth to half the thickness of the frame c^3 permits the oxygen produced in the corresponding cell O (Fig. 4), to pass into the conduit c^6 .

A groove or passage c^7 , also extending into half the thickness of the frame c^4 , permits the hydrogen produced in the corresponding cell H (Fig. 4) to reach the conduit c^7 .

c^9 is the inlet conduit formed by registering openings in the frames for the electrolytic liquid and grooves or passages c^8 , formed half way through the thickness of the frames c^3 and c^4 permit the electrolytic liquid to pass from the conduit c^9 into the cells of the elements.

Instead of being formed as just described, the frames c^3 and c^4 of each element may be constructed as shown in Figs. 5 to 8 inclusive. An orifice c^9 , preferably of rectangular shape, made in one side of each frame (right hand side Figs. 5 and 6) forms a part of the collecting conduit for one of the gases, oxygen for example, produced in the several elements.

This orifice c^9 communicates laterally with the interior of the frame through a notch or opening c^{10} , which constitutes the outlet for the oxygen cell O.

On the opposite side (left hand side Figs. 5 and 6) each frame is formed in a corresponding position with an orifice c^{11} , which

is of the same shape as the orifice c^9 , but has no lateral opening into the interior of the frame, and which constitutes a part of the collecting conduit for the other gas, hydrogen for example.

When assembling the apparatus, two frames c^3 and c^4 , formed in this manner, are placed together face to face in such a way that the asbestos diaphragm c^2 (Figs. 7 and 8) is clamped between them so that the side of the frame c^3 , in which is formed the notch c^{10} lies against the side of the other frame c^4 which has no such notch or lateral opening.

Fig. 6 shows two frames thus placed together and constituting with a diaphragm interposed between them and with an electrode, one element, and Figs. 7 and 8, which are sections along lines 7-7 and 8-8 respectively, Fig. 6, looking in the directions indicated by the arrows, show clearly the above described arrangement of the frames. The letters O and H represent respectively the cell in which is produced the oxygen, and that in which the hydrogen is produced.

When the frames are made of wood the orifices c^9 , c^{11} , through which the gases pass can be lined with small blocks of ebonite, vulcanite or other suitable material fitted to the frame by any suitable means, and exactly filling the orifices and provided with channels of varying number and size, so as to enable circulation to take place. In the arrangement shown in Figs. 5 to 8, the flanges c^5 , provided all around the electrodes in the arrangement shown in Figs. 3 and 4 are dispensed with.

It will be understood that instead of being formed in the upper portions of the two vertical sides of the frames c^3 or c^4 , as shown in Figs. 5 and 6, the orifices c^9 , c^{10} , c^{11} may be formed in the upper horizontal sides of the frames adjacent to their ends.

The frames of the several elements C, being made of wood or other relatively soft, compressible or elastic material, when clamped together between the central plate or head D and the end plates E E', form tight joints between the electrodes.

The two pressure regulators I with which the apparatus is furnished are identical. Each consists essentially (Fig. 9) of a cylindrical body or chamber i , in which is arranged a sheet metal float, i' , which regulates the pressure of the gas which arrives at i^2 and leaves at i^3 . The float i' is provided with a tube or stem i^4 guided in the inlet connection i^2 which extends upwardly into the chamber i above the bottom thereof. Inside the cylindrical body i is fitted a worm or coil i^5 for circulating water in order to cool the gas produced.

The pressure regulators and safety devices I may be supplied with sealing liq-

uid from the reservoir G, and the requisite liquid level is maintained therein by the extension of the inlet connections i^2 upwardly into the float chambers i .

It will be understood that the invention is not strictly limited to the details of construction shown in the accompanying drawings and described above, and that it will be possible in practice to make certain changes in the construction of the apparatus, and to modify it to a certain extent without departing from the spirit of the invention.

I claim:

1. In electrolyzing apparatus the combination of two supporting standards, parallel rods connecting the standards and insulated therefrom, an intermediate hollow plate forming an electrolyte chamber and end plates supported on and adjustable lengthwise of said rods, electrolyzing elements also supported on and adjustable lengthwise of said rods between the intermediate and end plates and each comprising a diaphragm interposed between two insulating frames, and a bipolar electrode applied to one of the frames parallel with the diaphragm, the frames of the several elements forming with the diaphragms and electrodes a series of cells, clamping means between the end plates and standards for pressing the elements together and forming tight joints between them, and connections with the intermediate plate for supplying electrolyte to and conducting the liberated gases from the apparatus, the diaphragms, electrodes and frames having registering openings forming electrolyte and gas conduits, the electrolyte conduit communicating with the several cells and each gas conduit with alternate cells through passages in the frames.

2. In electrolyzing apparatus the combination of two supporting standards, parallel rods connecting the standards and insulated therefrom, clamping plates supported on said rods, one of said plates being movable lengthwise of the rods toward and from the other, electrolyzing elements each comprising a diaphragm held between two insulating frames which form cells on opposite sides of the diaphragm and a metal plate electrode secured to the face of one of the frames parallel with the diaphragm and provided on opposite sides with lugs adapted to rest on said rods, clamping means connecting one of the standards and the adjacent clamping plate for pressing the elements together and maintaining tight joints between them, the several elements having registering openings forming electrolyte and gas conduits, the electrolyte conduit communicating with all the cells and each gas conduit with alternate cells through passages in the frames.

3. In electrolyzing apparatus the combination of parallel insulated supporting rods

and a series of electrolyzing elements each comprising a diaphragm held between two insulating frames which form cells on opposite sides thereof, and a metal plate electrode applied to one of the frames over the cell therein parallel with the diaphragm and provided on opposite sides with lugs adapted to rest on and shift lengthwise of said rods, and means for clamping the elements together on said rods, the several elements having registering openings forming electrolyte and gas conduits, the electrolyte conduit communicating with all the cells and each gas conduit with alternate cells through passages in the frames.

4. In electrolyzing apparatus an element comprising a diaphragm, two frames of non-conducting material secured together with the diaphragm between them and forming cells on opposite sides of the diaphragm, said frames having in the lower part thereof registering openings forming a passage for the electrolyte and in the upper part thereof registering openings forming conduits for the gases, the electrolyte conduit being connected by passages in the frames with the cells on both sides of the diaphragm and each gas conduit being connected by a passage in one frame with the cell on the opposite side of the diaphragm from that with which the other gas conduit is connected, and a metal electrode plate secured to the outer face of one of the frames parallel with the diaphragm and having openings registering with the conduit openings in the frames.

5. In electrolyzing apparatus, an element comprising an asbestos diaphragm, two insulating frames secured together with the diaphragm between them and forming cells on opposite sides thereof, and a sheet metal electrode secured to the outer face of one of the frames parallel with the diaphragm and having an extended undulatory face opposite the cell therein, the frames, diaphragm and electrode having registering openings forming an electrolyte conduit in the lower part thereof and gas conduits in the upper part thereof and the frames being formed with passages connecting the electrolyte conduit with both cells and each gas conduit with one cell on the opposite side of the diaphragm from that with which the other gas conduit is connected.

6. In electrolyzing apparatus, an element comprising an asbestos diaphragm, two insulating frames secured to the diaphragm and forming cells on opposite sides thereof, and a sheet metal electrode applied to the outer face of one of said frames parallel with the diaphragm and formed with a flange fitting over the edges of the frames, the frames, diaphragm and electrode having registering openings forming an electrolyte conduit and gas conduits and the frames

being formed with passages connecting the electrolyte conduit with both cells and each gas conduit with one cell on the opposite side of the diaphragm from that with which the other gas conduit is connected.

7. In electrolyzing apparatus the combination of a hollow head having electrolyte supply and gas delivery connections, a series of electrolyzing elements having electrolyte and gas conduits in communication with the supply and delivery connections of said head, pressure regulating and safety devices in said gas delivery connections each comprising a chamber having a gas outlet from the upper part thereof and a gas inlet extending upwardly into the lower part thereof, and an inverted cupshaped float surrounding and extending below the gas inlet, and an electrolyte reservoir connected with said hollow head and extending above the gas inlets of the pressure regulating and safety devices.

8. In electrolyzing apparatus the combination of a hollow head having electrolyte supply and gas delivery connections, a series of electrolyzing elements having electrolyte and gas conduits in communication with the supply and delivery connections of said head, pressure regulating and safety devices in said gas delivery connections each comprising a float chamber having a gas inlet extending upwardly into the lower part thereof and a gas outlet from the upper part thereof, an inverted cup-shaped float surrounding and extending below the gas inlet, a cooling coil surrounding the float, and an electrolyte reservoir connected with said hollow head and extending above the gas inlets

of the pressure regulating and safety devices.

9. In an electrolytic battery of the filter-press type, alternate members, one of said members constituted by a flat sheet and the other member consisting of a frame having a diaphragm supported therein.

10. In an electrolytic apparatus, the combination with diaphragm frames each having a diaphragm supported therein and having transverse gas passages through the top of the frame and a transverse electrolyte passage through the bottom of the frame; of thin sheet metal electrodes clamped between said diaphragm frames having openings therein for registration with said transverse passages.

11. In an electrolytic battery of the filter press type, alternate frameless sheet metal electrodes and frames containing asbestos diaphragms.

12. In an electrolytic apparatus of the filter press type, the combination with diaphragm frames each having a diaphragm mounted therein to divide the interior of the frame into two compartments and having two transverse gas passages through the top thereof, one of said passages being connected with the compartment on one side of the diaphragm and the other of said passages being connected with the other compartment, and electrodes alternating with the diaphragm frames and having holes registering with said passages.

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