No. 679,477. Patented July 30, 1901.

J. W. KYNASTON.

ELECTROLYTIC DECOMPOSING CELL.

(Application filed Feb. 1, 1899.)

(No Model.) 4 Sheets—Sheet 1.

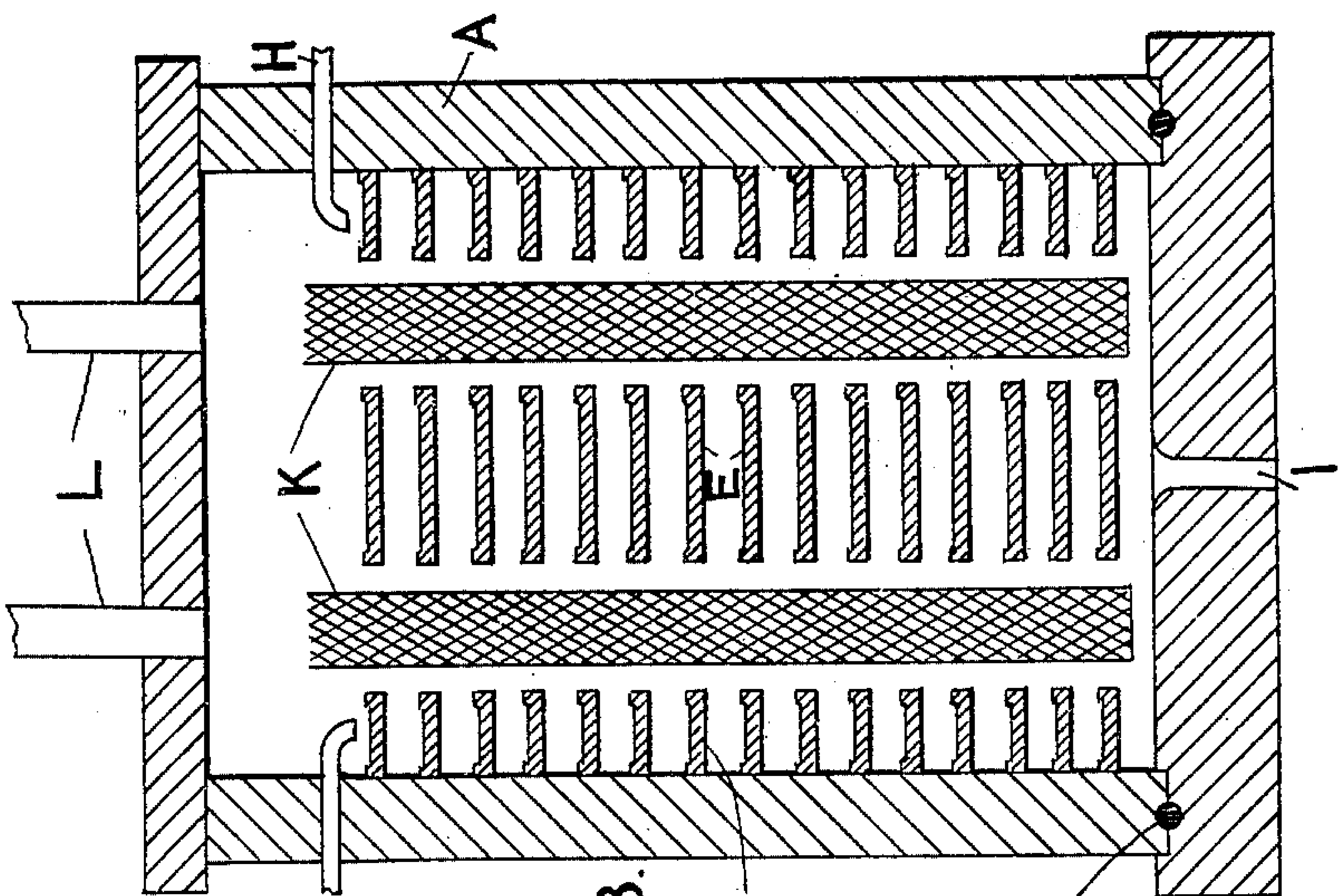

FIG. 3.

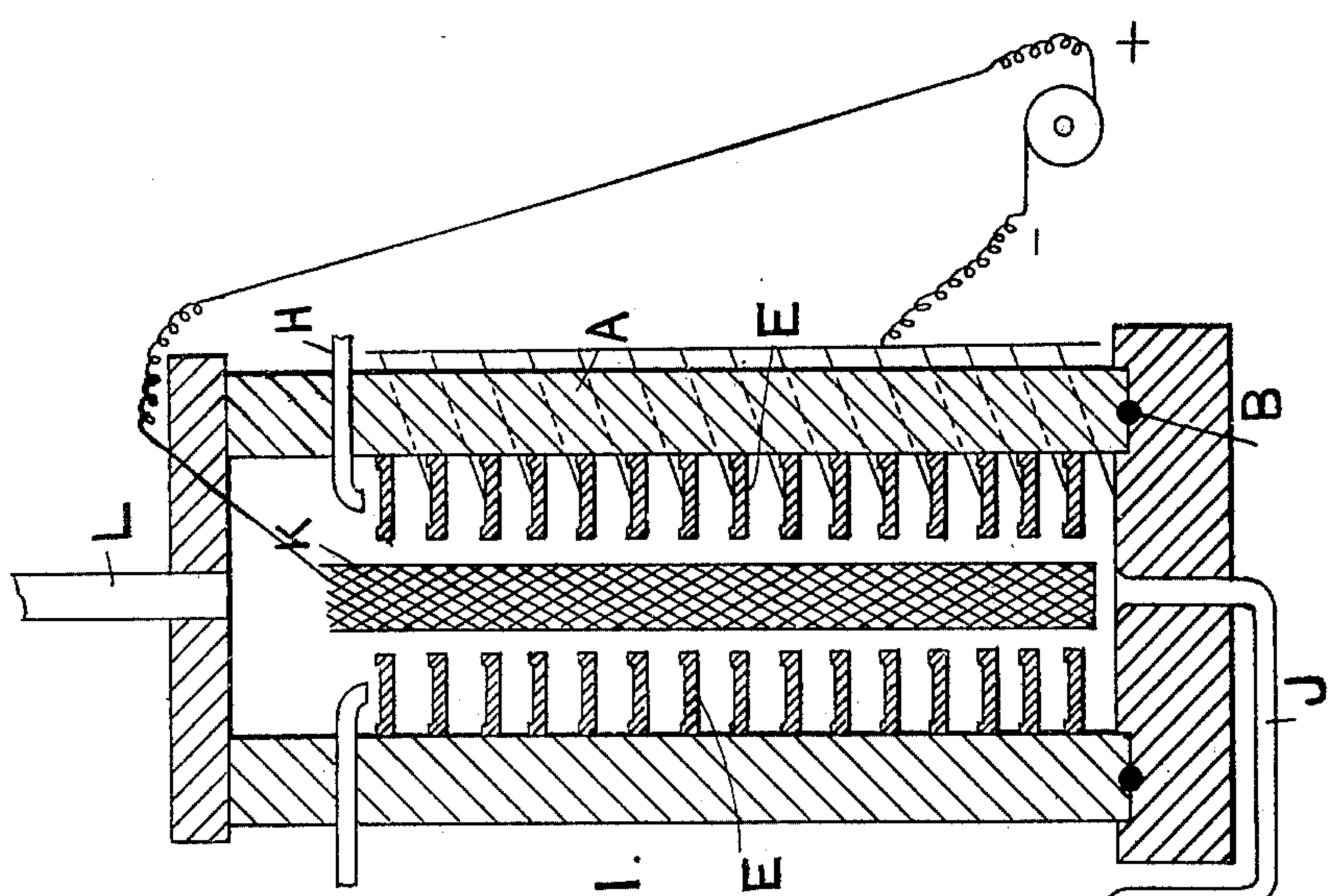

FIG. 1.

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FIG. 2.

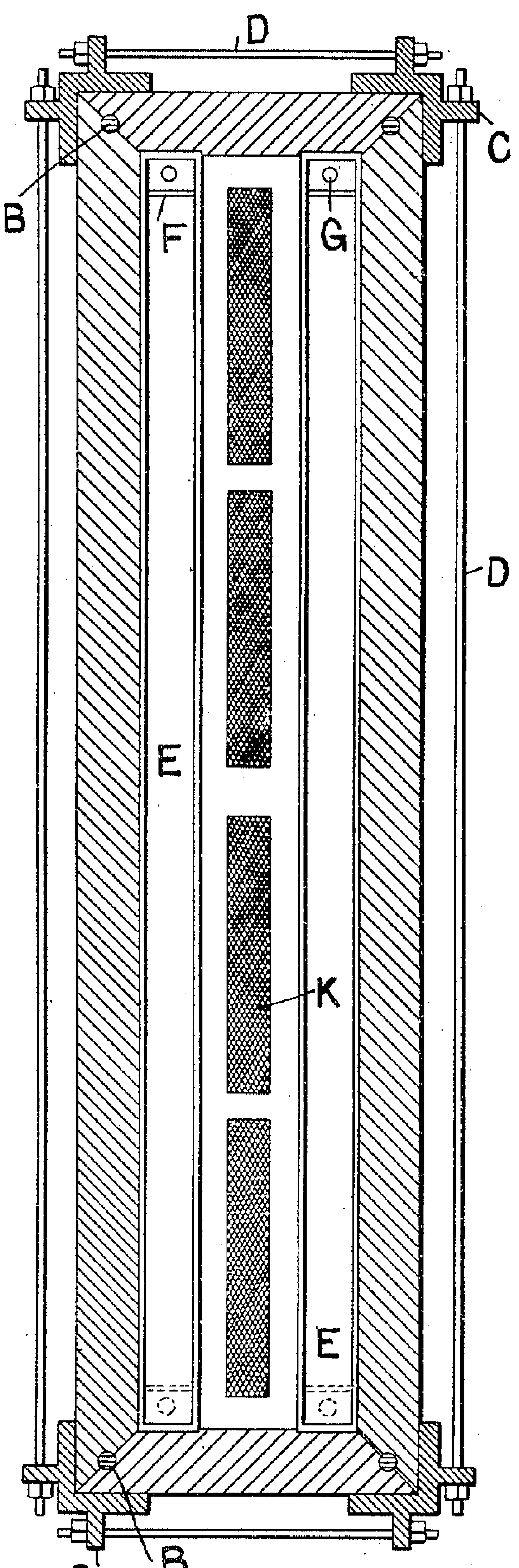
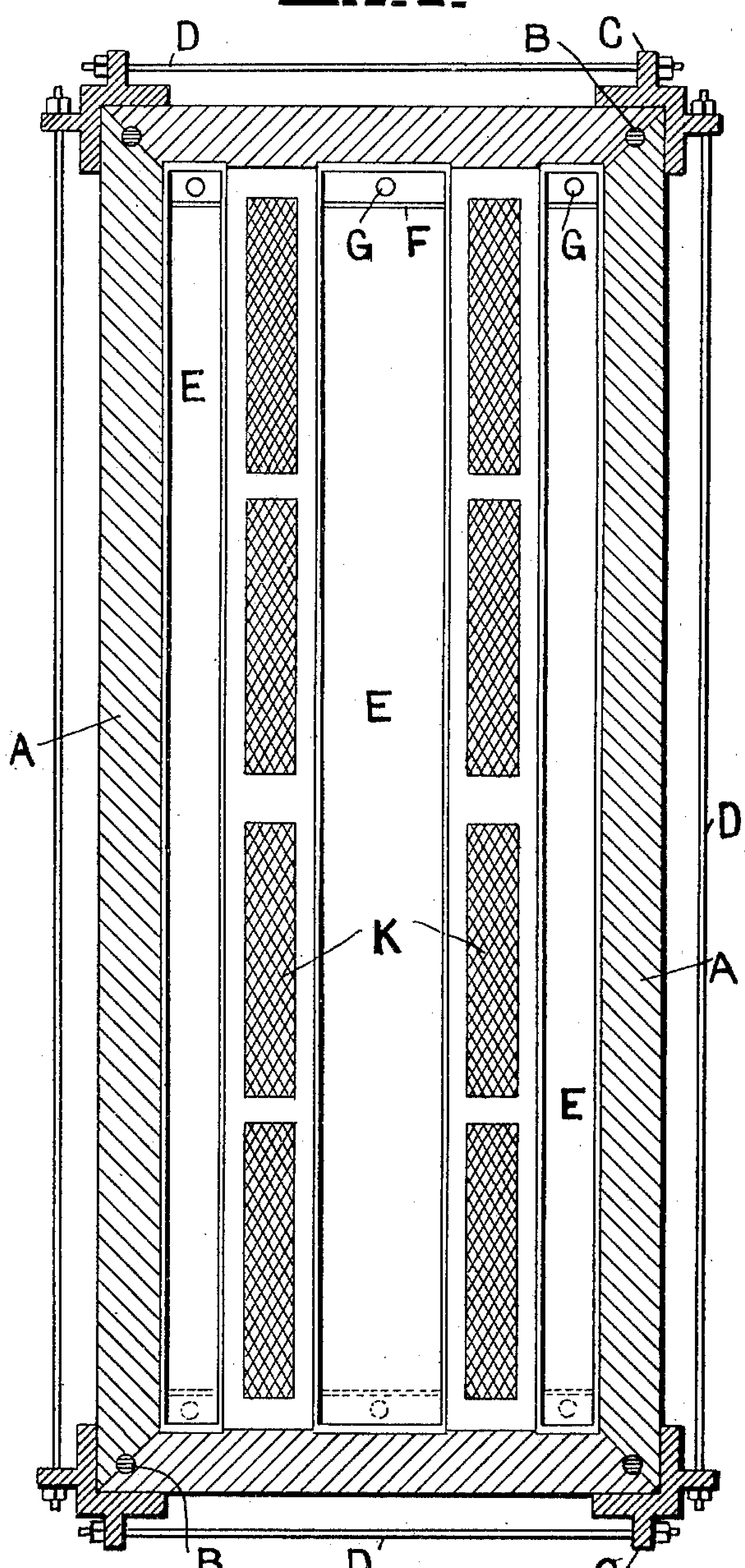


FIG. 4.



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(No Model.) 4 Sheets—Sheet 3.

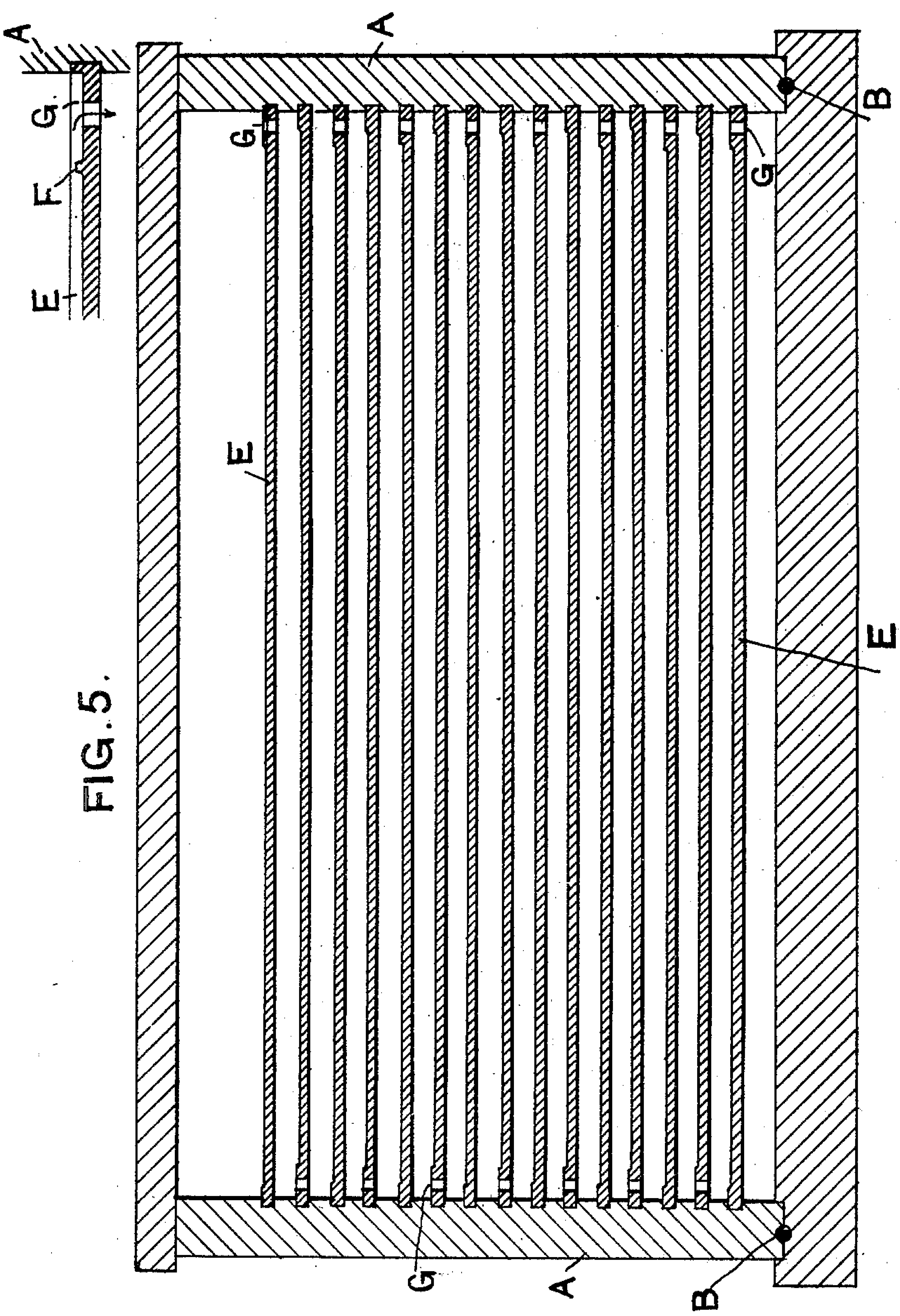

FIG. 5.

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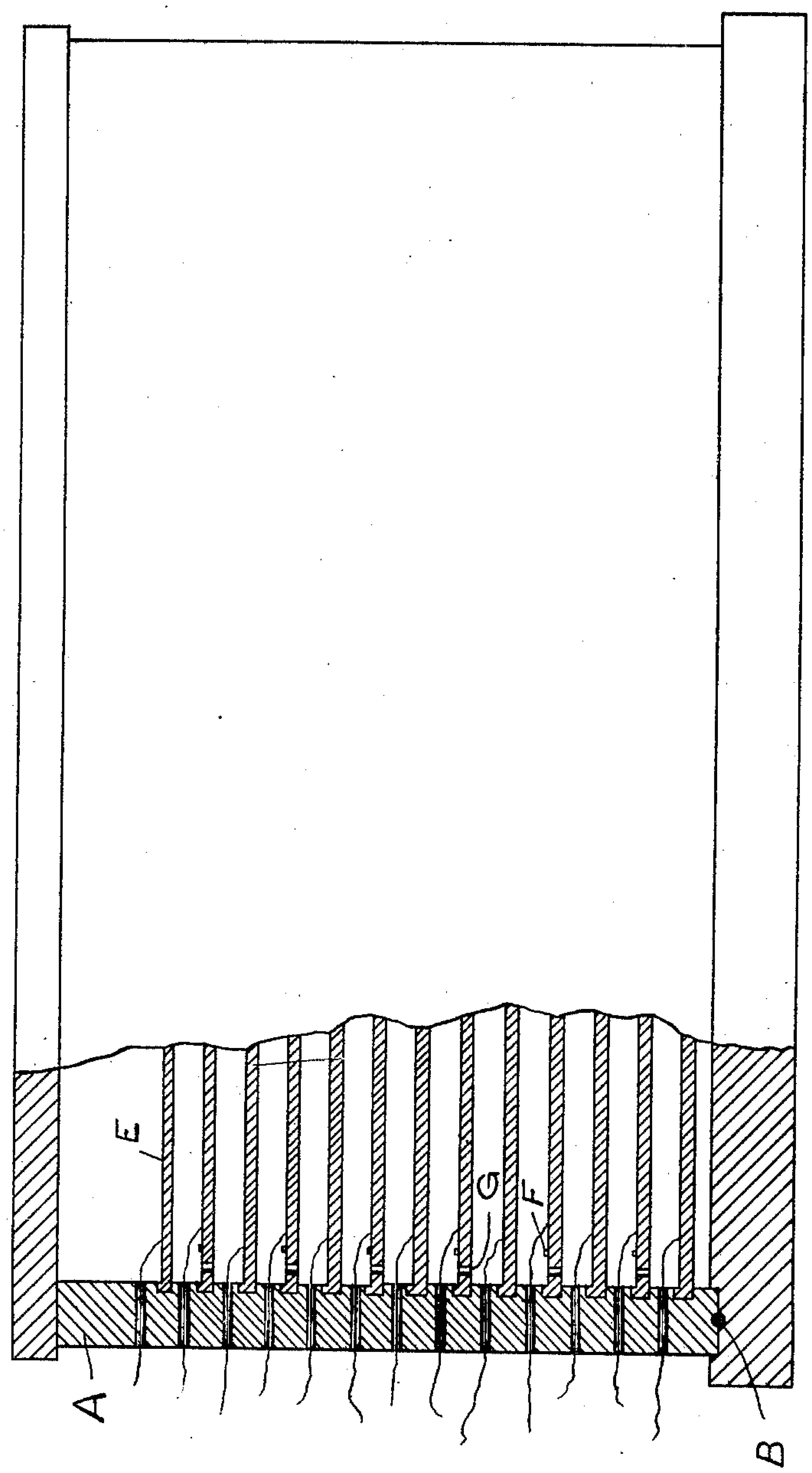
(No Model.) 4 Sheets—Sheet 4.

FIG. 6.



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UNITED STATES PATENT OFFICE.

JOSIAH W. KYNASTON, OF LIVERPOOL, ENGLAND.

ELECTROLYTIC DECOMPOSING-CELL.

SPECIFICATION forming part of Letters Patent No. 679,477, dated July 30, 1901.

Application filed February 1, 1899. Serial No. 704,079. (No model.)

To all whom it may concern:

Be it known that I, JOSIAH WYCKLIFFE KYNASTON, analytical chemist, a subject of the Queen of Great Britain, residing at Liverpool, in the county of Lancaster, England, have invented certain new and useful Improvements in Electrolytic Decomposing-Cells, of which the following is a specification.

In the decomposition by electrolysis of solutions of alkaline chlorids when metallic mercury is used as the cathode the production from a cell of given size has been relatively very small by reason of the nature of the liquid metal preventing it being placed in a vertical position parallel with the anode, and the amount of mercury surface is thus limited to the extent of the superficial area of the bottom of the cell. In order to obtain a better result, it has been proposed to have a vertical layer of mercury between porous diaphragms; but these diaphragms greatly increase the resistance of the cell, the heavy mercury cannot be maintained in position, and the difficulties in construction and working on such lines are so great as to be thought prohibitory. Another plan which has been proposed is to form a narrow helical channel of mercury, the flow passing alternately partly around the anode and then taking a turn through an oxidizing or denuding chamber. With such an arrangement it is difficult to get any increase of cathode-surface beyond that which the bottom of the cell would provide, while the mercury running down the narrow sloping gutter gains in impetus as it travels, breaks into short strings and globules, and thus the metallic continuity is destroyed even when the channels of mercury are of considerable depth. It is evident from the very nature of the liquid metal that extensive surfaces of mercury can only be obtained when it is spread in continuous layers on perfectly horizontal supports and that the extent of surface can be increased to any required degree by the system of superposed supports, which form the subject of my invention.

Now my invention differs greatly from what has gone before in that I provide very large surfaces of extremely thin mercury on, of course, horizontal trays arranged in series one above the other and so that the metallic sheet is maintained over the whole surface of the trays and the metallic continuity is unbroken. The mercury, passing into the cell at the topmost shelf or shelves, travels by gravity over each shelf below, continually increasing in strength as it progresses to the bottom, and is withdrawn from the cell as rich in alkali metal as it is possible practically to produce it. The motion of the mercury along the trays is effected by gravity and is due to the affinity which the globules of mercury have for each other when not subjected to agitation, their adhesion to each other serving to maintain constantly a layer in the trays, as it is continuously supplied at one end and withdrawn at the other. Hence the trays should be horizontal, or substantially so, whereby the flow of the mercury will be slow and uniform and the continuity of the body of mercury throughout the series of trays preserved.

My invention is best described by aid of the accompanying drawings, in which—

Figure 1 is a transverse vertical section, and Fig. 2 a plan, of what I call a "single" cell; Figs. 3 and 4, similar views of a double cell, and Fig. 5 a longitudinal section of either single or double cell. Fig. 6 is an elevation, partly in section, showing the electrical connections to the cathode.

In the drawings, A is a tank or cistern built up of flagstone, slate, or similar natural material, or I may use the artificial stone now commonly produced in large slabs or blocks. The stone forming the bottom of the inclosure must be of sufficient thickness and strength to bear without fear of fracture the weight to be placed upon it—that is, it must be considerably stronger than the sides, ends, and cover to be erected upon it. The joints are made tight by the insertion of india-rubber cord B in grooves, and the structure is firmly braced by means of brackets C and bolts D, exactly in the manner employed in the construction of hydrochloric-acid cisterns in alkali works.

In the simplest form of the cell (shown in Fig. 1) the approximate internal dimensions of the inclosure will be as follows: height about half the length, and breadth about one-sixth the length. For instance, in a cell of which the length is ten feet I make the height six feet and the breadth one foot nine inches.

Upon each of the sides of such an inclosure and running the entire length I arrange a series of narrow shelves E, of stone, natural or artificial, slate, glass, ebonite, vulcanite, or similar material, at a distance of a few inches from each other, the uppermost shelf being about one foot from the top of the inclosure and the lowest three or four inches from the bottom. The shelves are hollowed out on the upper surface to the depth of about one-half inch, the depression reaching to within one-quarter inch of the edges of the shelves. At the alternate ends of each of adjacent shelves and three inches from the ends a ridge F, one inch wide and one-eighth of an inch lower than the upper edge of the shelf, runs across it, and in the depression beyond the ridge a hole G, one inch in diameter, is bored through the shelf. Holes are bored through each of the sides or ends of the inclosure at a short distance above the level of the uppermost of the shelves, and an earthenware pipe H for the conveyance of mercury to the shelves is cemented firmly in the apertures. A hole I is also bored through the stone forming the bottom of the inclosure, and through this a wrought or cast iron pipe J, reaching to the upper surface of the stone, is firmly and tightly fixed. This pipe serves for the withdrawal of the mercury amalgam from the cell. K represents the carbon anodes. They are suspended through the cover of the inclosure in the central space between the shelves and extend to within a short distance of the bottom of the cell. L represents pipes for carrying away the chlorin evolved and also for conveying the chlorid solution to and withdrawing it from the cell. They are conveniently passed through the cover of the cell, and the usual arrangements are provided for maintaining a constant level of solution within the cell. I prefer to pass the solution into the cell at or near to its boiling-point of temperature.

Figs. 3 and 4, showing the double cell, have their parts lettered the same as the corresponding parts of Figs. 1 and 2 and only differ in having two anodes instead of one and between these two anodes a third series of shelves, the breadth of each of which is the sum of the width of two of the side shelves.

It is obvious that in the same way a triple, quadruple, quintuple, &c., cell may be constructed.

In putting the cell into operation the chlorid solution is run into the cell until the uppermost of the shelves is well covered. Mercury is then passed in, and, falling upon the uppermost shelf of each series, it fills the depression to the depth of about three-eighths of an inch and then falls through the opening at the farther end to the next shelf, and so on until all the shelves are charged. The supply of mercury is continued until the bottom of the cell is also covered to the depth of about half an inch. Connection is now made between the suspended carbon and the positive pole of an electric current and between the mercury on the bottom of the cell and the negative pole, the latter most conveniently by means of the iron pipe through which the amalgam is withdrawn from the cell. The flow of mercury into the cell is continued in a constant stream so regulated that the alkali metal amalgam flows out as rich in alkali metal as it is possible practically to produce it, while retaining perfect fluidity at the temperature at which the cell is worked. The chlorin evolved passes from the cell through the pipe provided for its escape.

Under ordinary circumstances the electric current flows freely through the amalgam on the bottom of the cell to that in the series of shelves by means of the constant stream falling from one to the other; but I prefer to place the metal on each of the shelves in independent metallic connection with each other of the series and the whole in independent connection with the metal on the floor of the cell. It will be understood, however, that this is not essential.

In thus describing my experimental apparatus I do not bind myself to these exact details of arrangement, as it is obvious that the cell can be made of other materials and of cylindrical or other form.

I declare that what I claim is—

1. An electrolytic decomposing-cell comprising a series of superposed horizontal or substantially horizontal trays each provided with an opening in one end arranged to deliver by gravity directly into the next tray beneath it, with the said openings alternating with each other, said trays adapted to contain a continuous stream of mercury to serve as a cathode; and an upright anode.

2. An electrolytic decomposing-cell comprising a series of superposed horizontal or substantially horizontal trays provided each with a transverse partition near one end, dividing the same into two portions of different dimensions alternating with each other, the said trays being provided in the smaller portions with holes arranged to deliver directly by gravity in the next tray beneath, and the said trays adapted to contain a continuous stream of mercury to serve as a cathode; and an upright anode.

3. An electrolytic decomposing-cell comprising a series of superposed horizontal or substantially horizontal trays formed each with an opening and arranged relatively to deliver by gravity directly to the next tray beneath, the said trays adapted to contain a continuous stream of mercury to serve as a cathode; and an upright anode.

4. An electrolytic decomposing-cell consisting of a series of superposed horizontal or substantially horizontal trays each formed to deliver by gravity directly to the next tray and over which trays mercury flows and covers the bottom of the cell and serves as a cathode; a vertical anode; means for introducing the mercury onto the topmost tray;

means for establishing electrical connection between the anode and cathode; means for introducing the electrolyte into the cell and withdrawing it from the same and for withdrawing the gas developed by the passage of the current, and means for withdrawing the resulting amalgam from the bottom of the cell.

In witness whereof I have hereunto signed my name, this 21st day of January, 1899, in the presence of two subscribing witnesses.

J. W. KYNASTON.

Witnesses:
G. C. DYMOND,
ALBERT C. B. HENRI.