Mar. 13, 1923. 1,448,037.

R. PECHKRANZ.

ELECTROLYSIS OF WATER.

FILED JULY 12, 1922.

Fig. 2.

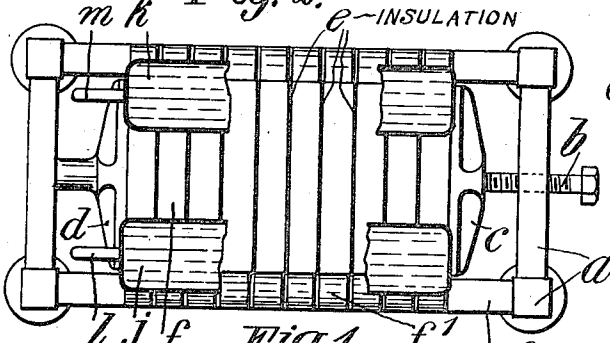


Fig. 3.

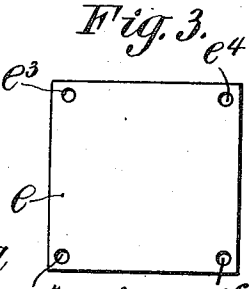


Fig. 1.

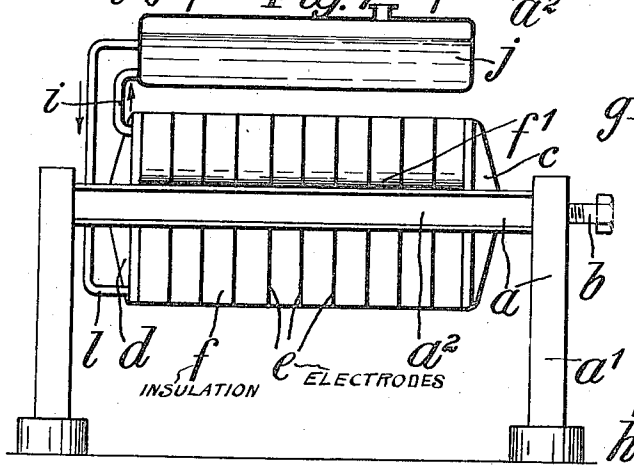


Fig. 6.

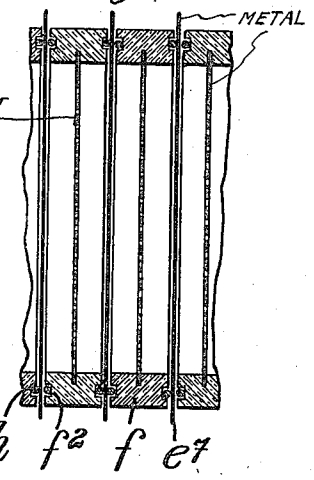


Fig. 4.

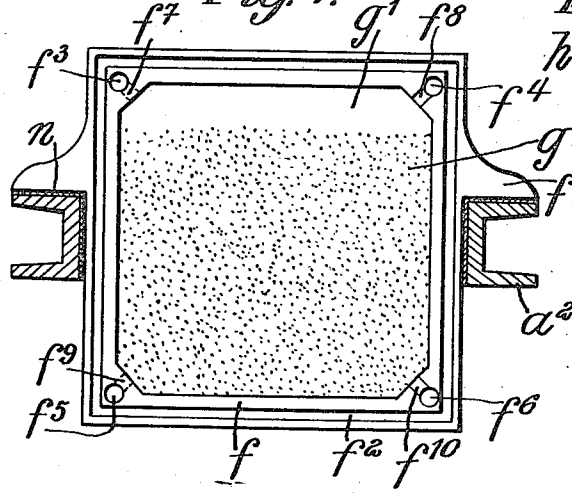
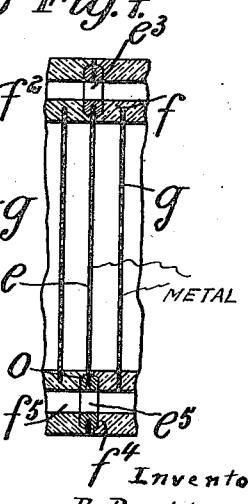


Fig. 5



Fig. 7.



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UNITED STATES PATENT OFFICE.

RODOLPHE PECHKRANZ, OF GENEVA, SWITZERLAND.

ELECTROLYSIS OF WATER.

Application filed July 12, 1922. Serial No. 574,482.

To all whom it may concern:

Be it known that I, RODOLPHE PECHKRANZ, a citizen of Switzerland, residing at Geneva, Canton of Geneva, in the Confederation of Switzerland, have invented certain new and useful Improvements in or Relating to the Electrolysis of Water, of which the following is a specification.

The use of metallic partitions in apparatus for the electrolysis of water is well known.

Their advantages in comparison with the customary, usual mineral partitions can however, as careful study and exhaustive experiments have shown, only be properly developed in the case of water decomposing apparatuses built on the filter press principle, if the metallic partitions be made as extremely thin and finely perforated.

Whereas the great advantage of very thin metal partitions has been hitherto unknown, attention has on the other hand already been directed to the use of a small perforation, though not for extremely thin metal partitions it is true. It was absolutely necessary found however that it was to restrict these small perforations to a few centimetres above the lower edge of the electrodes, so as to prevent mixture of the gases.

A more general perforation appeared formerly to lead to very extensive defects, as there was risk that not only the electrolyte, but also the gas evolved would be allowed to pass through.

These previously known types of construction involve compared with those according to the present invention a great waste of material, current and amount of space occupied.

The water decomposer according to the present invention is built on the filter press principle, with electrodes of thin sheet metal, the partitions which are arranged between the electrodes and which are likewise of metal, being made extremely thin and perforated with very fine holes, so that at most only a fractional part of their total surface is left solid.

In the accompanying drawing is diagrammatically illustrated by way of example a constructional form of the apparatus and detail modifications.

Figs. 1 and 2 are an elevation and a plan respectively of the constructional form.

Fig. 3 is an elevation of an electrode.

Figs. 4 and 5 are two vertical sections, at right angles to each other, through this constructional form, and on a larger scale.

Figs. 6 and 7 show detail modifications.

As shown in Figs. 1 and 2 this constructional form has a frame a, which consists of four standards a^1 and a frame a^2 on which latter the elements of the apparatus rest. By means of a screw b, the elements, which are clamped between the cast plates c, d, arranged at both ends of the apparatus, can be pressed very strongly against each other, so that the general arrangement of this apparatus corresponds to that of an ordinary filter press.

The electrodes e are made of thin sheet metal, the thickness of which is shown on a very exaggerated scale in the drawing, and may amount to a fractional part of millimetre, are of rectangular form (see Fig. 3) and are arranged between frames f (see Figs. 4 and 5). The electrodes e are simply held by pressure and friction in the correct position which is determined by the thickness of the frame. The frames f, constructed of an insulating material, such as pressed asbestos cement, hold the partitions g, which are made of metal, and also are very thin and are provided with numerous small holes.

A narrow strip g^1 at the top of the partitions is however solid, in order to prevent the two gases from diffusing into each other, whereby large bubbles of gas might collect.

The partitions g may be made for example of a thin sheet of pure nickel or a metal belonging to the nickel group, which has been obtained by electrolysis, or they may consist only of pure nickel in preponderance. Such partitions secure uninterrupted working, as it is not necessary to remove them from the apparatus from time to time.

The frames f are supported by means of lugs f^1 on the frames a^2 and are provided on both their side surfaces with a groove f^2 which runs all round them and in which

a strip or band of some compressible material, for example rubber, is laid so as to provide a packing between the frame f and the electrode e. At the four corners of the rectangular frames f are provided holes f^3, f^4, f^5, f^6, which are situated at right angles to the plane of the frames and run from end to end of the apparatus, and which form with corresponding holes e^3, e^4, e^5, e^6 pierced in the electrodes e passages which run throughout the entire length of the apparatus. In addition to this the holes f^2, f^4, f^5, f^6 are each connected by holes f^7, f^8, f^9, f^{10}, which are arranged parallel with the plane of the frame, to one of the two spaces which exist on both sides of an electrode e. At one end the passage e^3—f^3 communicates by a pipe i with a gas separator j in which for example the separation of the hydrogen from the gas electrolyte emulsion takes place. One end of the passage e^4—f^4 is also connected by a pipe to a second gas separator k which is provided for the separation of the oxygen from the gas electrolyte emulsion, for example. The electrolyte, which is separated in the gas separator j from the hydrogen, flows through the pipe l and the passage e^5—f^5 back into the space on the right hand of the electrode e from which it originated. In the same way the electrolyte flows out of the gas separator k^1 through the pipe m and the passage e^6—f^6 into the spaces on the left of the electrodes e from which it escaped as an emulsion with the gas through the passage e^4—f^4. When a solution of caustic potash is used as the electrolyte, the gas bubbles separate somewhat more slowly than they do when the potassium carbonate solution now customary is employed, so that it is advantageous to return the electrolyte which runs back, to each of the spaces from which it came, and not, as is usual, to return those portions of the electrolyte which issue from the different spaces, to all these spaces in a mixed state. The purity of the gases obtained is thereby augmented. On the other hand an unequal concentration of the electrolyte in the two groups of frames owing to unequal wandering of the ions, is not to be feared as the metallic partitions g allow for thorough mixing.

The electrodes e are separated from the frames a^2 by an insulating layer n, so that they are not connected in parallel across it, which means that no trace of any separation of gas can be detected at the partitions g so long as double the water decomposing voltage is not available per element.

As shown in Fig. 6 the electrodes e are larger than the frames f, so that they have parts which project between and beyond these latter at e^7 which parts serve to cool the electrodes. In this illustration the electrodes and the frames are shown in the position which they occupy before they are pressed together.

It is obvious of course that the holes provided for the formation of the longitudinal passages may also be arranged outside the frame.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A water decomposing apparatus of the filter press type comprising electrodes formed of thin sheet metal, extremely thin partitions formed of metal arranged between said electrodes, said partitions being provided over substantially their total surface, with extremely minute perforations.

2. A water decomposing apparatus of the filter press type comprising, electrodes formed of thin sheet metal, extremely thin partitions consisting essentially of nickel and arranged between said electrodes, said partitions being provided over the greater part of their entire surface, with very fine perforations.

3. A water decomposing apparatus of the filter press type comprising, electrodes formed of thin sheet metal, very thin metal partitions arranged between said electrodes, said partitions being provided over the greater part of their entire surface, with very fine perforations, frames of insulating material receiving said partition and being provided with a number of longitudinal passages, holes in the electrodes to correspond with the passages, said passages each being connected by holes arranged parallel with the plane of the frame, to one of two spaces which exists on each side of the partitions.

4. A water decomposing apparatus of the filter press type comprising, electrodes formed of thin sheet metal, very thin metal partitions and arranged between said electrodes, said partitions being provided over the major part of their entire surface, with very fine perforations, rectangular frames of insulating material for receiving said partitions and provided with four longitudinal passages arranged in the corners of the said frames of corresponding holes in the electrodes, said passages being each connected by holes arranged parallel with the plane of the frame to one of two spaces which exists on each side of the partitions, an upper passage being connected to a gas separator, and a second upper passage being connected to a second gas separator.

5. A water decomposing apparatus of the filter press type comprising, electrodes formed of thin sheet metal, very thin metal partitions arranged between said electrodes, said partitions being provided over

the greater part of their surface, with very fine perforations, frames of insulating material receiving said partitions, and being positioned adjacent the electrodes said electrodes being so dimensioned as to project out beyond the frames, whereby their projecting part serves for cooling the electrolyte.

In testimony whereof I have affixed my signature in presence of two witnesses.

RODOLPHE PECHKRANZ.

Witnesses:
ROD. DE WURTEMBERG,
EDM. EMMANUEL.