J. H. MONGE & C. ARZANO.

ELECTROLYTIC APPARATUS.

APPLICATION FILED AUG. 27, 1907.

945,132.

Patented Jan. 4, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

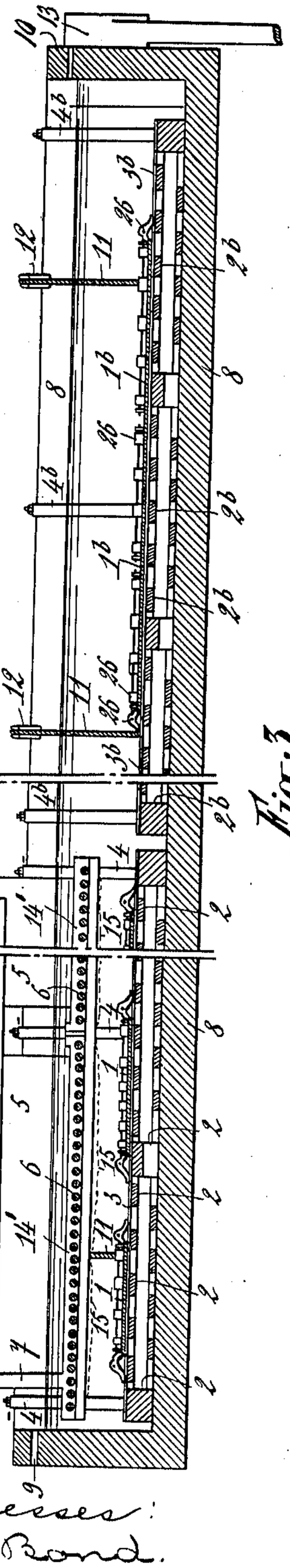
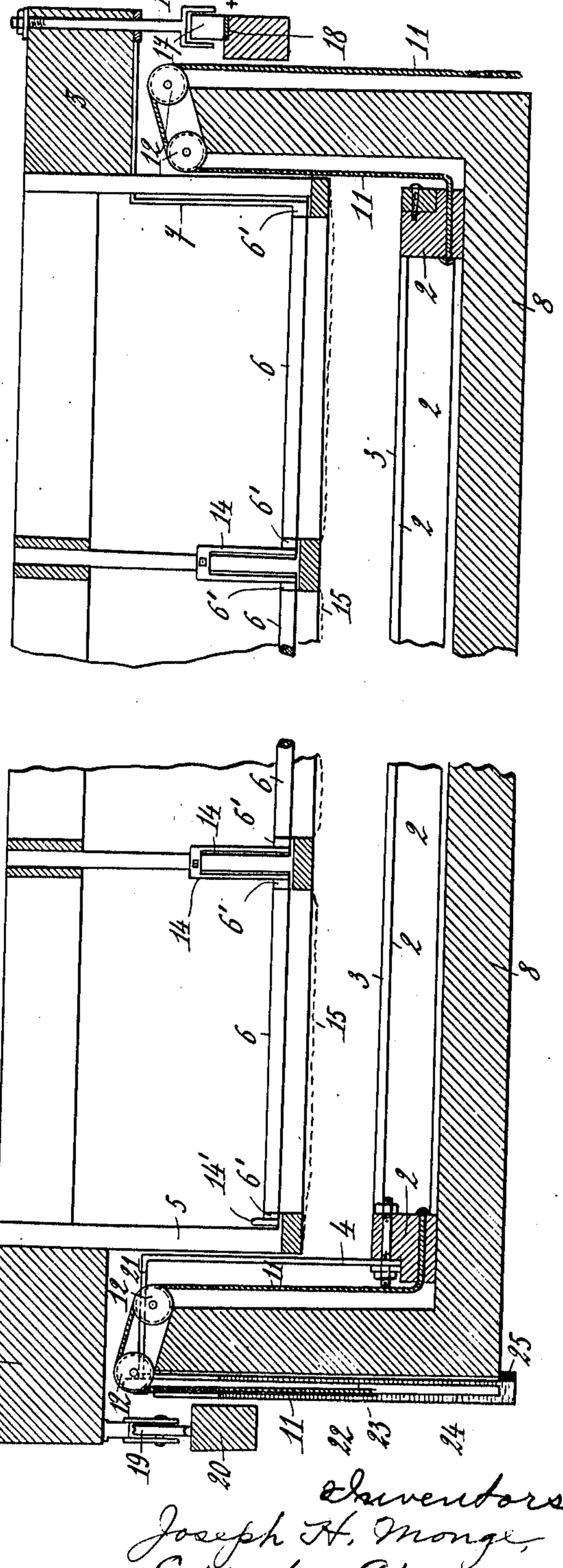



Fig. 3.

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2 SHEETS—SHEET 2.

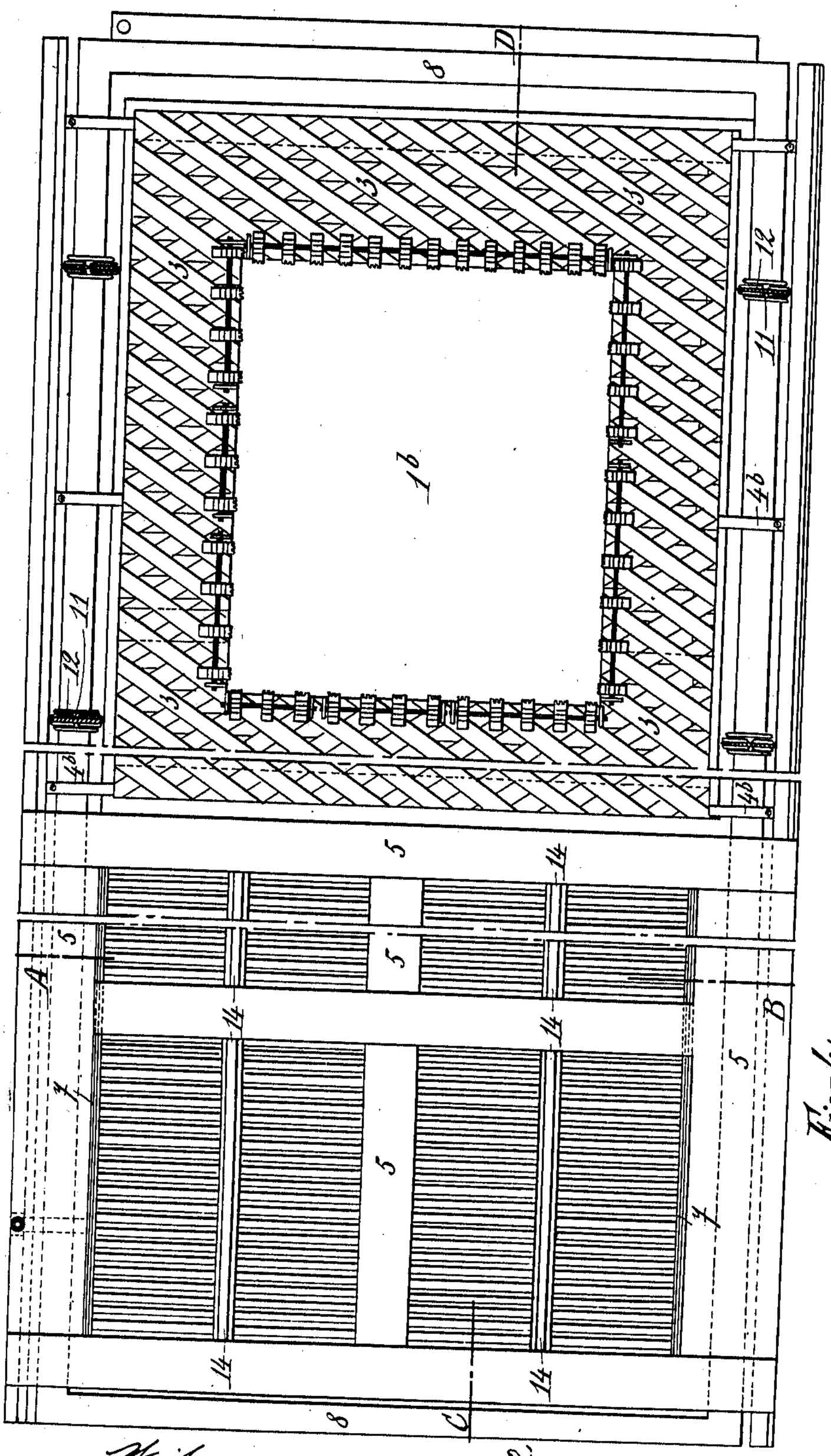


Fig. 2.

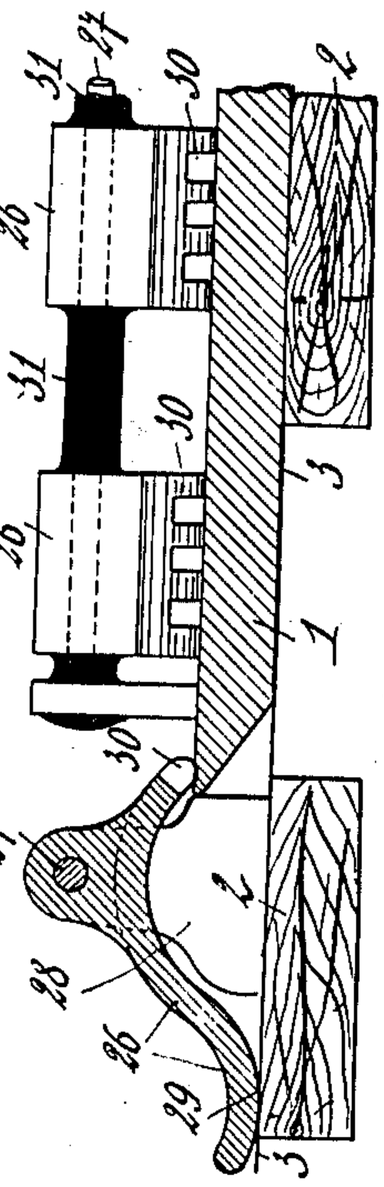


Fig. 4.

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# UNITED STATES PATENT OFFICE.

JOSEPH HENRI MONGE AND CORRADO ARZANO, OF ST. GILLES-LEZ-BRUXELLES, BELGIUM.

## ELECTROLYTIC APPARATUS.

945,132. Specification of Letters Patent. **Patented Jan. 4, 1910.**

Application filed August 27, 1907. Serial No. 390,365.

*To all whom it may concern:*

Be it known that we, JOSEPH HENRI MONGE, a citizen of the French Republic, residing at St. Gilles-lez-Bruxelles, Belgium, and CORRADO ARZANO, a subject of the King of Italy, residing at St. Gilles-lez-Bruxelles, Belgium, have invented certain new and useful Improvements in Electrolytic Apparatus, of which the following is a specification.

This invention relates to covering by electrolysis the silver plating of mirrors and the like with a suitable protective metal coating, preferably of copper.

The main object of the invention is to apply electrolytic copper plating to the silver plating of mirrors in a regular uniform and economical manner, without damaging the layer of silver and so that the operations follow each other quickly, are carried out in a continuous manner and on a large industrial scale.

The invention first of all consists in maintaining continuously a uniform proportion between the surfaces of the anodes and cathodes placed in the electrolytic bath, for any current of given strength, that is to say, in maintaining a uniform density of current in spite of variations in the surfaces to be plated, while enabling the supply of the current to be preserved during the introduction and removal of the mirror glasses.

The invention further consists in arranging the mirror glasses in the electrolytic bath in such a manner that while a glass or a group of glasses is being plated, another glass or group of glasses is introduced into the bath and subjected to a preliminary electrolytic action.

According to this invention, moreover, the glasses or mirrors to be treated are arranged in a horizontal position and an agitation of the liquid in a parallel direction, that is to say, in a horizontal direction, takes place above the surfaces to be plated.

The invention comprises further a method of bringing the current to the surface of the silver on the mirror in such manner as to distribute the current in a uniform manner, starting from the edges of the mirrors to be covered, the mirror being arranged opposite the anode. The apparatus employed enables the work to be carried out on a large scale for industrial purposes.

The apparatus is chiefly characterized by the arrangement of an electrolytic bath comprising the anode which consists of carbon rods on a carriage occupying about half the length of the tank and arranged to be moved in a longitudinal direction without interrupting its connection with the current supply terminal, and two perforated frames each supporting a network of copper blades forming a cathode, the said frames being arranged so that they can be moved in a vertical direction, (that is to say, raised from the bath or lowered into the same) while also remaining in connection with their current supply. The two frames with their networks of conductor blades constitute a cathode surface practically twice as large as the surface of the anode supported by the carriage, the anode being brought opposite either one or the other half of the cathode when the latter is lowered into the bath.

The open-work conducting surface of the frame is intended to support the mirror or mirrors to be coated and constitutes a compensating surface which always provides substantially the same cathode surface opposite the anode, whatever be the size of the mirrors which cover the conductor network.

The devices for collecting current are constituted by movable parts which can be moved on the conducting surface, they rest on the one hand on the latter, and on the other hand just on the edge of the silver plating of the mirror, and they are provided with an insulating layer opposite the anode, so that they communicate current to the silver plating through their bottom surface. They are arranged so as to pivot on rods of insulating material, with interposition of insulating parts, and are threaded beforehand on the said rods according to the length of the line of contact (length of the edge of the mirror) to be coated, so that the distribution of current is always effected in a uniform manner. Owing to their mobility on the insulating rods, they can, by adapting themselves to all the small inequalities of the conducting surface of the frame produce reliable contacts with the edges of the mirror.

An apparatus constructed according to this invention, is illustrated by way of example, in the accompanying drawings.

Figure 1 is a longitudinal section on the line C—D of Fig. 2. Fig. 2 is a plan view. Fig. 3 is a cross-section on the line A—B of

Fig. 2. Fig. 4 is a detail view on an enlarged scale, showing the arrangements of the contact parts.

A vat 8 of elongated shape provided with an inlet 9 for liquid and an outlet 10, contains the electrolytic liquid, the level of which is practically that of the two orifices 9 and 10. The said vat comprises two horizontal perforated frames 2 and $2^b$, each covered with a net-work of copper blades 3, $3^b$, respectively, connected by conductors 4 and $4^b$, to the negative pole and constituting the cathode. The said cathode is thus constituted by two halves 3 and $3^b$ each of which is intended to support the mirrors (1 and $1^b$) or groups of mirrors to be treated. Above these two frames 2 and $2^b$, is arranged a horizontal carriage 5 carrying series of rods 6 constituting an openwork anode. In the construction shown in the drawing, this anode is constituted by carbon rods 6 (non-soluble anode), the ends of which 6′ Fig. 3 are copper plated by electrolysis and pressed between connecting pieces 14 and 14′ made of copper or other metal. Conductors 7 connect the rods and their connecting parts to the positive pole of the source of electric current. All the metal parts of the anode are protected by an insulating varnish. Below the anode is arranged a filtering bag or screen intended to retain impurities etc.

The horizontal frames 2 and $2^b$ can be raised and lowered by means of cables 11 passing over pulleys 12. In these vertical movements, the cathodes must remain connected to the source of current. In the example illustrated, the conductors 4 are connected for the purpose to conducting parts 21 communicating with plungers 22 arranged in conducting vessels 24 charged with mercury 23 and connected by collector devices 25 to the negative pole of the source of current.

The horizontal carriage 5 supporting the anode can be moved in a horizontal direction in order to be brought either above the cathode 2 or above the cathode $2^b$. To that end, the carriage, supported by rollers 17, 19, travels on tracks 18 and 20. The rail 18 is a conductor and the rollers 17 communicating by means of conductor parts 16 with the conductors 7 of the anode, are also conductors, so that the anode thus always remains connected to the positive pole of the source of current during its movement.

The mirrors to be treated 1 and $1^b$, are placed flat on the cathode support 3, $3^b$, with the silver-plated surface upward, the glass being in contact with the supporting network. In order to obtain a reliable connection of the silver-plated surface of the mirror with the conducting surface of the cathode-support, as well as to obtain a uniform distribution of current starting exactly from the edges of the mirror, the special connecting or contact device shown in detail in Figs. 2 and 4 is employed. The said contact devices are movable and can be freely moved on the surface of the supporting cathode and distributed at will, so as to render the distribution of current suitable or in proportion to the area of the silver-plated surface to be copper-plated by electrolysis. The contact device consists of a series of conductors or connecting fingers 26 pivoted on a rod or pin 27 of insulating material supported in brackets 28 also made of insulating material. Each pivoting finger 26 is curved or bent in such manner that when its tail 29 (Fig. 4) touches the plates or blades 3, its head 30, preferably cut in the form of teeth, rests on the edge of the silver-plating.

In carrying out the invention in practice, several fingers 26 are mounted or threaded beforehand on a common spindle 27. Sockets or sleeves 31 of insulating material are inserted between the different fingers 26 so as to space them apart in a uniform manner.

When the mirror or mirrors are arranged on the supporting cathode, the various contact devices put on beforehand and constituting complete systems (Fig. 2) are placed against the edges of the mirrors. The supports 28 striking the edge or bevel of the mirror prevent the head 30 of the conductor fingers from advancing to an excessive extent beyond the edges of the silver plating.

Owing to the fact that the contact fingers 26 can pivot independently of each other on their spindle 27, perfect contact is insured throughout the whole length of the edge, the fingers fitting into any small inequalities of the surface of the supporting cathode. The pivoting action and their curved shape also enable them to adapt themselves to different thicknesses of mirrors.

In order that the metal should be deposited in the desired manner, that is to say, on the silver plated surface, and not on the connecting fingers, the latter are covered with an insulating varnish at their upper surface, that is to say that which is facing the anode.

The best method of obtaining durable contact parts without any faulty insulation at the edges etc., consists in enameling the parts 26 entirely in the furnace and in baring them afterward on the under surface of the tail 29 and of the head 30.

The mirrors to be plated are placed on the cathode 3, $3^b$ with the glass surface downward, and the silver plated surface upward. The frame 2 or $2^b$ is to that end, raised by means of the cables 11. When the mirror or mirrors are placed on the frame, the contact parts 26 mounted on their supports 27 28 are distributed around them, and the silver plating thus connected with the network of blades 3, $3^b$. The cathode is then consti-

tuted partly by the network of copper blades, and partly by the silver-plated surface. It will be seen, therefore, that the surface area of the cathode proper, that is to say the active surface of the cathode is always uniform whatever be the area of the mirrors to be treated. It is true that owing to the covering of the open portions of the conductor network, there is a slight increase of the surface area resulting from the application of the mirror. Nevertheless this slight increase of active surface which necessarily varies with the different areas of the mirrors treated, is compensated by this part of the cathode being brought nearer to the anode due to the thickness of the mirror. Thus in practice no effective increase of the cathode surface takes place, or it constitutes an absolutely negligible factor.

It follows from the arrangement of the supporting cathode that the density of current always remains uniform in spite of the variations of the surface areas to be covered.

When the glasses $1^b$ have been placed on the frame $2^b$, $3^b$ the latter is lowered into the bath. During this time the other half of the cathode 2, 3, provided with its glasses, is being treated, the anode 5, 6, having been placed above the cathode 2, 3. This working treatment enables the glasses $1^b$ arranged on the frame $2^b$, $3^b$, to be subjected owing to their presence in the electrolytic bath and to their distance from the cathode, to a preliminary treatment whereby they are covered with a slight film of copper, which greatly assists the subsequent copper plating proper. Owing to this progressive action of the bath, the silver plating is protected against any too sudden electrolytic action which might be injurious.

When the deposition of metal on one half of the cathode 2, 3, has been completed, the carriage 5, and 6, is pushed toward the other half $2^b$, $3^b$, and the glasses $1^b$ which have been subjected to the preliminary treatment, are now subjected to the proper working treatment, while the mirrors are being removed from the first supporting cathode to be replaced by others intended to be subjected successively to the preparatory treatment and to the working treatment proper. The treatment of mirrors can thus be carried on in a continuous manner, without having to modify it to suit difference of surfaces, thickness of mirrors etc.

What we claim as our invention and desire to secure by Letters Patent is:

1. An electrolytic apparatus comprising a cathode support consisting of openwork frames covered with a plurality of copper blades and means to lift the cathode support out of or lower it into the bath while remaining connected to the source of current.

2. An electrolytic apparatus comprising a cathode support consisting of two openwork frames covered with a plurality of copper blades and cables guided by rollers to lift the cathode support out of or lower it into the bath while remaining connected to the source of current.

3. The combination of an electrolytic bath, a cathode support, freely movable contact pieces thereon, the said contact pieces being covered on the outer side facing the positive electrode with insulating material, their opposite faces being bare to act as conductor faces when resting in contact with both the surface of the supporting cathode and the edges of the silver plating of the mirror.

4. The combination of an electrolytic bath, a cathode support, insulated rods movable thereon, freely oscillating contact pieces on said rods, interposed insulating pieces on said rods, insulating supports on said rods for abutting against the glass edges of the mirrors and preventing said oscillating contact pieces from making contact beyond the edge of the silver plating of the mirror.

5. An electrolytic apparatus comprising a carriage with an anode carried thereon, a cathode support consisting of two separated openwork frames covered with a plurality of copper blades and means to move the said carriage longitudinally of the tank alternately over the two parts of the cathode support.

6. An electrolytic apparatus comprising a carriage, a carbon anode carried thereon, conductor rollers connected to the said anode and conductor rails on which the said conductor rollers roll so that the carriage can move longitudinally of the tank while remaining connected to the source of current.

7. An electrolytic apparatus comprising a carriage, a carbon anode carried thereon and means to move the said carriage longitudinally of the tank, while remaining connected to the source of current, the said anode comprising carbon rods provided with ends copper-plated by electrolysis and mounted in copper supports, all the metal parts of the anode being covered with an insulating varnish.

8. An electrolytic apparatus comprising a cathode support consisting of two openwork frames covered with a plurality, of copper blades, means to lift the cathode support out of or lower it into the bath while remaining connected to the source of current, conductors connected to the network of copper blades and conductor tubes containing mercury connected to the source of current and placed outside the tank to receive the ends of said conductors.

9. The combination of an electrolytic bath, a cathode support consisting of two openwork frames covered with a plurality of copper blades, cables guided by rollers to lift the cathode support out of or lower it into the bath while remaining connected to the

source of current, conductors connected to the cathode conductor tubes containing mercury connected to the source of current and placed outside the tank to receive the ends of the said conductors, a carbon anode, a carriage for said anode, conductor rollers connected to said anode, conductor rails on which the said conductor rollers roll in a longitudinal direction of the tank while remaining connected to the source of current, insulated rods movable on the said cathode support, freely oscillating contact pieces on said rods interposed insulating pieces on said rods, the said contact pieces being covered on the outer side facing the anode with insulating material their opposite faces being bare, and inlet and outlet tubes or orifices for the liquid in the said bath, the said orifices being arranged practically at the same level above the mirrors being treated.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

JOSEPH HENRI MONGE.
CORRADO ARZANO.

Witnesses:
A. GRAETZ,
M. FREYBERG.