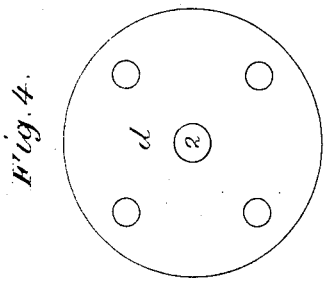
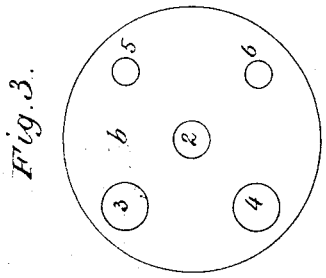
(No Model.)

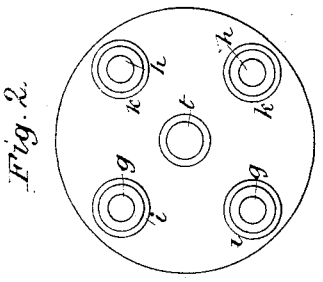
A. G. BELL & S. TAINTER.

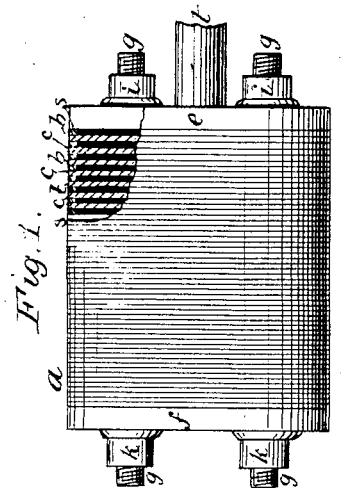
Selenium Cells.

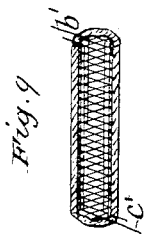
No. 235,497. Patented Dec. 14, 1880.

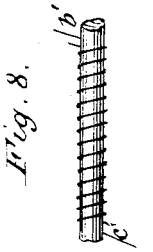


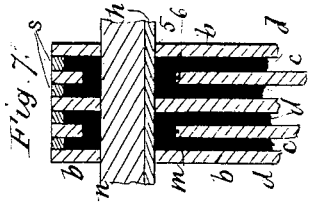


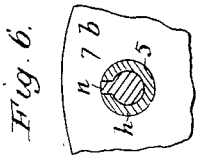


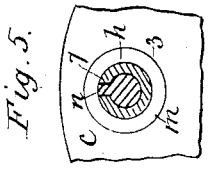


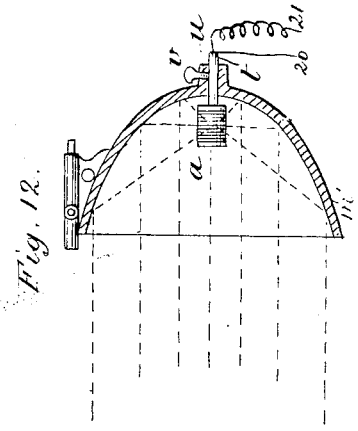


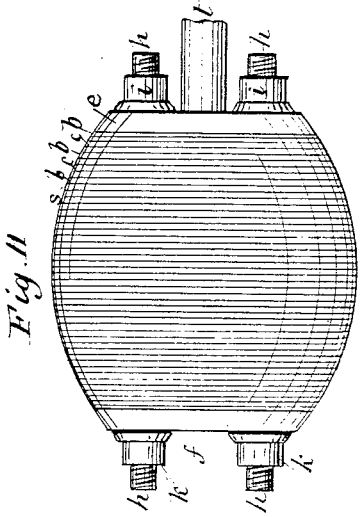


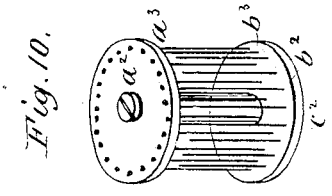












Witnesses
E. E. Masson
Philip Pollock

Inventors
Alexander Graham Bell
and Sumner Tainter
by A. Pollok
their Attorney

UNITED STATES PATENT OFFICE.

ALEXANDER G. BELL, OF WASHINGTON, DISTRICT OF COLUMBIA, AND SUMNER TAINTER, OF WATERTOWN, MASSACHUSETTS.

SELENIUM-CELL.

SPECIFICATION forming part of Letters Patent No. 235,497, dated December 14, 1880.

Application filed September 25, 1880. (No model.)

To all whom it may concern:

Be it known that we, ALEXANDER GRAHAM BELL, of Washington, District of Columbia, and SUMNER TAINTER, of Watertown, county of Middlesex, and State of Massachusetts, have invented an Improvement in Selenium-Cells, of which the following description, in connection with the accompanying drawings, is a specification.

Our invention relates to selenium-cells or instruments containing selenium as a part of an electric circuit.

In an application of Alexander Graham Bell, filed August 28, 1880, an apparatus was shown and described for transmitting sound or producing variations in electric currents by the action of a beam of rays from the sun or other radiant bodies. The said apparatus contained an instrument having selenium in an electric circuit, the resistance whereof is varied in accordance with variations in the active force of the rays falling on the said selenium. In the said application various forms of instruments or cells containing selenium were described, some of which were not therein claimed, as they were not invented by the said Bell. One of the forms therein described consists generically of two or more pieces of conducting material, held separated from one another by insulating material arranged to leave spaces between the said two conductors and insulating material to be filled with selenium, which thus completes the electric circuit between the said pieces of conducting material. The form specifically claimed in the said application consisted of rectangular plates of conducting material supported by insulating material arranged to leave a portion of the space between the said plates unoccupied thereby. The said space is filled with selenium, which connects the conducting-plates and lies in a plane surface to be exposed to radiant action. In one form of receiving-instrument shown in the said application a parabolic mirror was used to concentrate the rays on the sensitive selenium, and when such a mirror is used it is found advantageous to construct the cell so as to afford a curved surface to be acted upon on all sides by the rays. An instrument of this kind (shown in the said application, but not therein specifically claimed,) together with several modifications thereof, forms the subject of the present application.

Figure 1 is a side, and Fig. 2 an end, elevation of a cell constructed in accordance with this invention; Fig. 3, one of the plates of conducting material, and Fig. 4 one of the plates of insulating material detached; Figs. 5, 6, and 7, sectional details showing the method of connecting the plates of conducting material; Figs. 8, 9, and 10, modifications showing a different arrangement of the conducting and insulating materials; Fig. 11, a modification showing a different form of curved surface, nearly normal throughout, to the rays falling thereon; and Fig. 12, a view of the condensing-mirror and selenium-cell therein.

The cell *a* (illustrated in the first seven figures, together with Figs. 11 and 12) is composed, mainly, of circular disks *b c*, of conducting material, and disks *d*, of insulating material, of slightly smaller diameter, interposed between them. By this arrangement annular channels are left between the edges of the conducting-disks *b c* around the periphery of the insulating-disks *d*.

The disks *b c d* are all provided with central holes, 2, to enable them to be held in proper position on a mandrel in the process of making the cell, where they are clamped between two suitable end plates, *e f*. The disks of conducting material, which is preferably brass, are alternated on the said mandrel with disks *d* of insulating material, which may be mica. The conducting-disks are electrically connected together in two sets of alternate plates, *b c*, between which the circuit is completed by the annular rings of selenium *s*, filling the channels around the disks of insulating material *d*. This connection is accomplished as follows: The disks are provided with holes. (Shown as four in number.) In the conducting-disks two of the holes, 3 4, are of larger diameter than the other two, 5 6, which are of the same size as all four of the holes in the insulating-disks.

In placing the disks on the mandrel the holes are all placed with their centers in line, and the large holes 3 4 of each conducting-disk are in line with the small holes 5 6 of the conducting-disks on each side of it; or, in other

words, in a given line of holes all those of the plates *b* will be of different diameter from those of the plates *c*.

A cylinder of conducting material, of a diameter equal to that of the small holes, driven through a line of holes, will touch and electrically connect the alternate conducting-plates having their small holes in that line, and will not touch the other plates.

Two of the cylinders, *g*, will connect together all the disks of one set, as *b*, which can be connected with one terminal of the circuit, and the other two cylinders, *h*, will connect the disks of the other set, *c*, which can be connected with the other terminal; but the two sets *b c* will be connected only by the selenium *s*.

In order to insure a more perfect connection between the plates *b* and cylinders *g*, and the plates *c* and cylinders *h*, the said cylinders are made tubular and one or more slots, 7, cut longitudinally through their sides.

Washers *m*, of insulating material, are placed within the large holes 3 4, in the conducting-disks, so that the said washers completely insulate and separate that portion of the said disks from the cylinders.

Conducting material in a fluid or mobile state—as, for example, melted type-metal or metal filings—is poured into the tubes *g h*, and, passing through the longitudinal slots 7, makes a perfect connection with the plate, having small holes 5 6 around the said tubes, as shown in Figs. 6 and 7, where the mobile metal is indicated by the letter *n*, but is prevented by the washers *m* from making a contact with the plates having the large holes adjacent to it, as shown in Fig. 5.

Instead of the washers *m* of insulating material, smaller washers or rings of any material—as, for instance, metal—may be used to confine the mobile metal and prevent its contact with the plates at the large holes, the said rings themselves being too small in external diameter to touch the said disks. When the parts of the cell are thus properly put together it is heated to a temperature somewhat higher than the melting-point of selenium, which is rubbed over the surface of the cell and melts into and fills the annular channels between the disks *b c*, thus connecting the two said disks in such manner that an electric current can pass from one to the other through the annular rings of selenium *s*.

When solidified, on cooling, the selenium is to be treated by a suitable process, in order to acquire the properties of conductivity and sensitiveness to the action of rays, which properties it does not possess when solidified from a liquid.

A process of treatment is fully described in another joint application for United States Letters Patent, filed by us August 28, 1880, to which reference may be had.

It is sufficient to state here that the selenium should be heated as nearly as possible to its temperature of fusion without allowing it to actually melt, and then cooled, when it will be found to possess the desired properties.

When the selenium is fused upon the surface of the instrument it covers the exposed edges of the conducting material, besides filling the channels between the said edges. The best results have been obtained by removing (by filing or otherwise) the selenium covering, the surface of the conducting material leaving only that lying between the plates of conducting material to be exposed by the rays.

In the form shown in Figs. 8 and 9 the two electrodes *b' c'*, instead of consisting of a large number of separate pieces electrically connected together, are shown as single electric conductors or wires arranged near but not in contact with each other for a considerable portion of their length. The wires *b' c'* are supported on and held in proper relative position to one another by a cylindrical mass of insulating material, (shown in Fig. 8 as a glass rod,) upon the outside of which the two wires are wound in parallel coils, and in Fig. 9 as a glass tube containing the wires similarly coiled inside of it. In this instance spiral channels are formed between the wires and the insulating material, which may be filled with selenium to electrically connect the said wires. The selenium will afford a cylindrical surface to be acted upon by rays from all sides as when placed at the axis of a parabolic mirror.

In Fig. 10 the two electrodes a^2 b^2 are mechanically connected by a standard, c^2, which is electrically insulated from the electrode a^2. Each electrode is provided with a series of projections, a^3 b^3, extending toward the other electrode, those of one series lying between, but not in contact with, those of the other series. When the spaces between these projections are filled with selenium the latter connects the electric circuit between the electrodes and affords a cylindrical surface to be acted upon by rays from all sides.

In the form shown in Fig. 11 the construction is the same as that of the instrument shown in Fig. 1; but the surface is spheroidal instead of cylindrical, so that when the cell is placed with its center corresponding to the focal point of the condensing-mirror, the rays will all fall upon it in a direction substantially normal to the surface, so as to produce the greatest effect.

Nuts *i k* on the ends of the cylinders *g h* hold the disks together, making the whole cell a solid durable structure. The nuts *i* in the ends of the cylinders *g* and the said cylinders are insulated from the end plate *e*, while the cylinders *h* and nuts *k* thereon are insulated from the end plate *f*, so that the said end plates cannot complete the electric circuit between the two sets of plates *b c*, respectively connected together by the cylinders *g* and *h*.

When the cells are completed the mandrel, if of conducting material, should be removed, and a rod or tube, *t*, may be inserted in one of the end pieces, as *e*, to serve as a handle or

standard for manipulating or supporting the cell.

In Fig. 12 a cell, *a*, is shown on a reduced scale as supported with its center near the focal point of a parabolic condensing-mirror, *m'*, the tube *t* being held in a socket, *u*, at the vertex of the mirror by a set-screw, *v*. The electrodes 20 and 21 pass out through the said tube *u*, and may be connected with any desired electrical apparatus.

I claim—

1. In an instrument containing selenium as a portion of an electric circuit, a series of electric conductors arranged to form a cell having a curved bounding surface, and selenium interposed between the said conductors in the said curved surface to complete the electric circuit, substantially as described.

2. In an instrument containing selenium as a portion of an electric circuit, a series of electrically-conductive disks and disks of insulating material to separate them of slightly smaller diameter than the adjoining conducting-disks, and selenium in the annular channels surrounding the periphery of the insulating-disks to connect the conducting-disks, substantially as described.

3. In an instrument to interpose selenium in an electric circuit, a series of electrically-conductive disks and insulating-disks of smaller diameter to separate them, and selenium to connect them at their edges, combined with electrical connectors arranged to connect the alternate conductive disks together in one set and the remaining interposed conducting-disks as another set, substantially as described.

4. A selenium-cell composed of plates of conducting material separated by plates of insulating material and connected at their edges by selenium, all the said plates being provided with holes arranged in line to form a continuous passage through the entire cell, the holes in the alternate conducting-plates in one line being larger than those in the interposed conducting-plates in the same line, which are all uniform in size, combined with a conductor of the same size with and inserted in the small holes, to electrically connect together all the plates having the small holes without forming electrical contact with those having the larger holes, substantially as described.

5. In a selenium-cell, a series of conducting and insulating plates provided with holes of different size arranged in line, as described, to form a passage through the cell, combined with electric conducting material inserted in the said passage in a mobile state, and washers placed within the large holes, whereby the conducting-plates containing the small holes are electrically connected by the inserted conducting material, and the said conducting material is prevented from making electrical contact with the plates containing the large holes, substantially as described.

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

ALEXANDER GRAHAM BELL.
SUMNER TAINTER.

Witnesses to the signature of Alexander Graham Bell:

ALFRED J. MAYO,
C. H. GREAVES.

Witnesses to the signature of Sumner Tainter:

PHILIP MAURO,
BARTRAM ZEVELY.