No. 743,410. PATENTED NOV. 10, 1903.

C. E. ACKER.

ELECTRODE AND CONDUCTOR.

APPLICATION FILED JUNE 5, 1902.

NO MODEL.

Fig. 1. Fig. 2. Fig. 3.

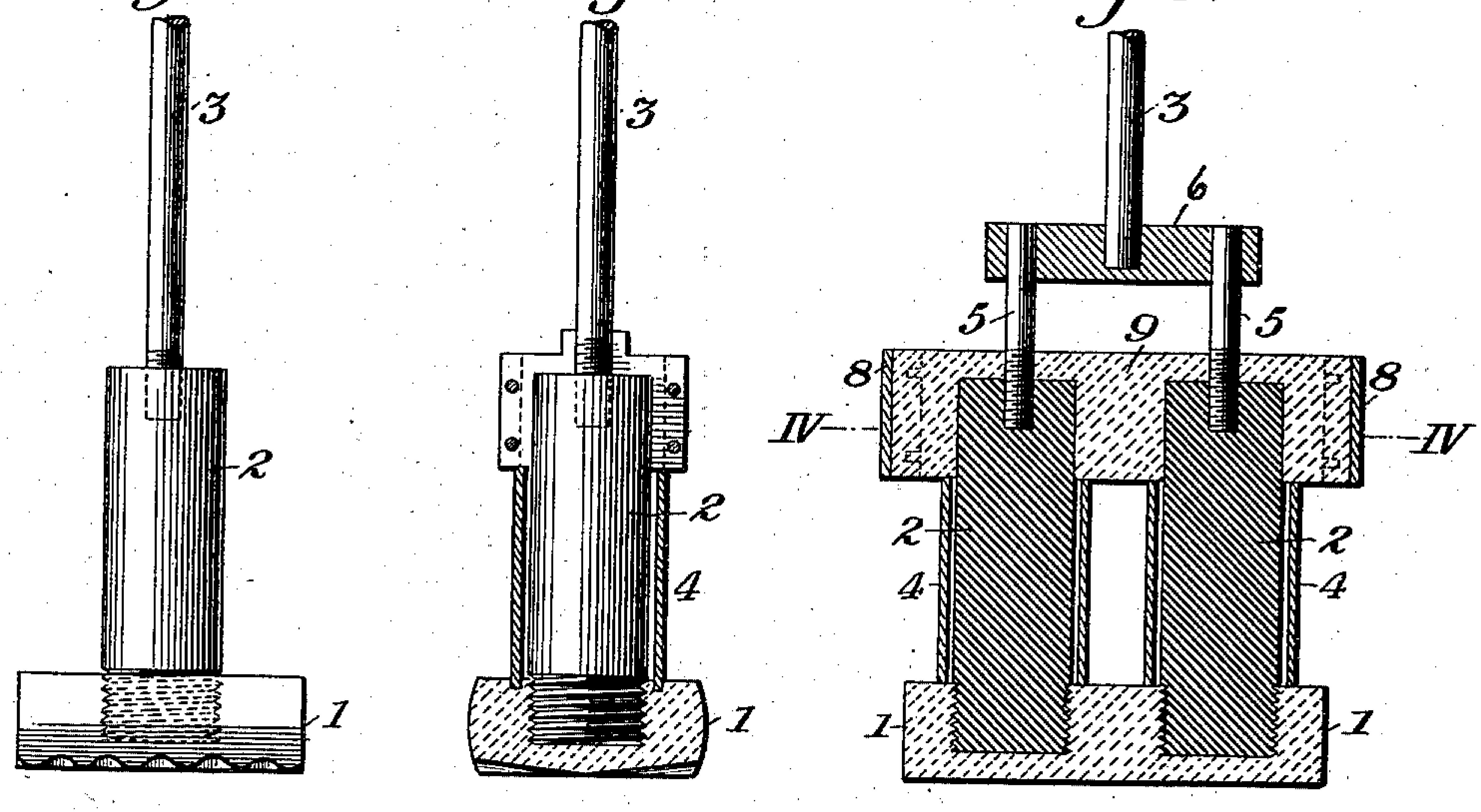
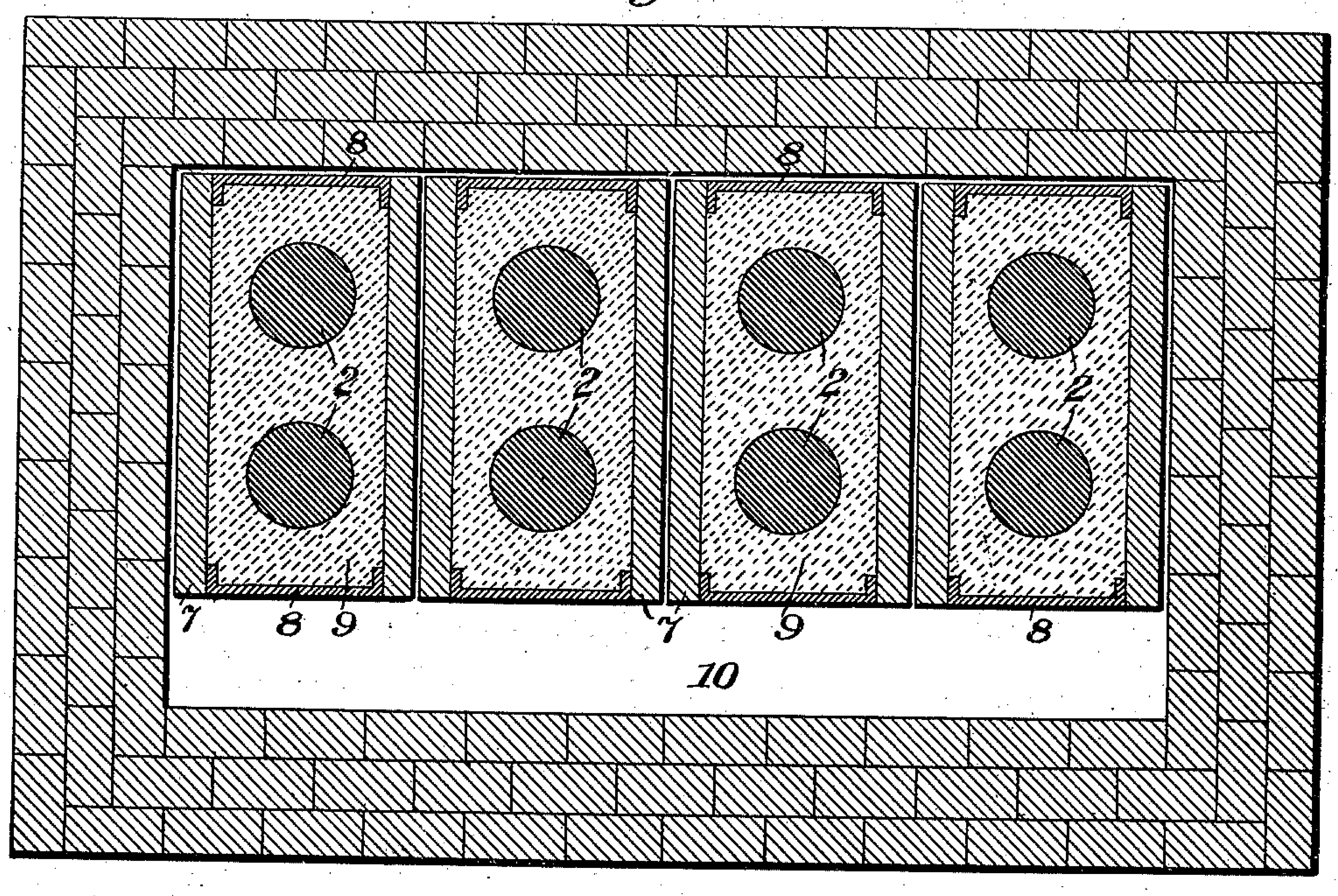


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES ERNEST ACKER, OF NIAGARA FALLS, NEW YORK.

ELECTRODE AND CONDUCTOR.

SPECIFICATION forming part of Letters Patent No. 743,410, dated November 10, 1903.

Application filed June 5, 1902. Serial No. 110,337. (No model.)

To all whom it may concern:

Be it known that I, CHARLES ERNEST ACKER, a citizen of the United States, residing at Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Electrodes and Conductors, of which the following is a specification.

This invention comprises a carbon electrode and conductor designed particularly for use in those electrolytic operations in which high current densities are employed.

Referring to the accompanying drawings, wherein corresponding parts are indicated by the same reference-letter, Figure 1 is a side elevation of one form of electrode. Fig. 2 is a modification thereof, shown in part vertical section. Fig. 3 shows in vertical section a further modification wherein a plurality of conductors are applied to a single block, and Fig. 4 is a plan view showing a number of electrodes of the form illustrated in Fig. 3 assembled in an electrolytic vat or furnace.

Referring to Fig. 1, 1 represents a carbon block, the lower active surface of which may be corrugated or grooved in such manner as to permit the ready escape of evolved gases. The grooves are preferably, as clearly shown in the drawings, so formed and spaced with relation to each other that gases liberated upon any portion of the active face of the electrode may find an outlet through them. To facilitate the escape of the gases, the grooves are preferably deepened somewhat toward the periphery of the electrode, thereby affording upwardly-inclined surfaces, along which the gases may travel. In addition to affording a path of escape for the gases the grooves serve to increase the active surface of the electrode in contact with the electrolyte. The grooves should be so formed as to avoid the formation of pockets or cavities in which gases might collect. 2 is a carbon shank secured to the block 1 by screw-threads, by dovetailing, or in any suitable manner. 3 is a metallic conductor, shown as united by screw-threads to the shank 2, but which may be clamped or otherwise suitably secured thereto.

In Fig. 2 the shank 2 is shown as secured by screw-threads to the block 1 and the metallic conductor 3 as clamped to the carbon shank. The carbon shank 2 in this construction is protected by a tube or sheath 4, of fire-clay or other refractory material, which surrounds it and prevents access of atmospheric oxygen to the heated carbon. This tube or sheath is advantageously supported upon the carbon block and may be let into its upper face, as shown.

In Fig. 3 the block 1 is supported by a plurality of shanks 2, shown as two in number and each surrounded by a tubular casing 4. As shown, these shanks are connected, by means of metal rods 5 and the yoke 6, to a common metallic conductor 3.

It is desirable to protect also the juncture between the carbon shank and the metallic conductor, and this can be conveniently effected by the construction shown in Figs. 3, 4, in which 7 7 are slabs of soapstone or other refractory material united by plates or grids 8, which may be of iron, thus forming a casing, the interior of which is filled with cement 9. As shown, this refractory casing is of somewhat greater area than the carbon block 1, and when the series of electrodes are assembled in the furnace 10, as shown in Fig. 4, these casings form a cover, which substantially prevents loss of heat and escape of gases from the furnace. It results from this construction that when the several casings are in substantial contact the carbon blocks are sufficiently spaced to permit the furnace charge to be fed between them. This protective casing for the joint between the metal conductor and the carbon shank may be applied to individual connectors, or a single casing may inclose two or more connectors.

In electrolytic operations utilizing high current densities—for instance, in the electrolysis of fused salts—it is necessary in the design of the electrode to consider several independent factors. The current density must be suited to the requirements of the operation and is determined by the area of the active face of the electrode, in this case the lower face of the block 1. Further, there must exist a definite relation between the cross-sectional area of the block 1 and the shank 2, which serves as the conductor and support. The shanks must be of sufficient strength to support the block and of sufficient cross-section to carry the desired current without undue heating On the other hand, their size is limited by the necessity for affording room for feeding the furnace and properly controlling its operation and by the further necessity for maintaining at a minimum the heat conducted by them from the furnace. It will be seen that the determination of these factors of strength and thermal and electrical conductivity depends directly upon the physical constants of the material selected. I have found that the best material for the purpose is a carbon composition, which is not molded, but in contradistinction thereto is forced under heavy pressure through dies. By this procedure only can the necessary density and homogeneity be secured. I form both the anode-blocks 1 and the shanks 2 of this material, which may be graphitized to increase their electrical conductivity and to facilitate tooling.

It will be clear from the foregoing explanation that the cross-sectional area of the working head or block and the shank are determined by entirely different factors, that of the head by the current density appropriate to the bath and that of the shank by the conductivity of the carbon for the particular current. It results that the shank if composed of the same material as the head must be of relatively reduced sectional area. An integral electrode of this form comprising a shank and head of different cross-section might be formed by molding, but such molded electrode would not endure in a fused electrolyte. According to my invention the head 1 and block 2 are both of carbon, which has been forced under great pressure through dies, as above described. This is rendered possible by the sectional construction illustrated. Other advantages secured by the sectional construction are the facility which it affords for renewal and repair of parts and for the assembling of the complete or sheathed electrode. In case of injury to any part the electrode is readily dismounted, repaired, and again assembled.

One specific example of the use of my electrode is as follows: The electrolyte is sodium chlorid, which in operation is maintained in fusion by the passage therethrough of the current. The carbon blocks may be eight and three-fourths inches wide by thirteen and one-half inches long by four inches thick, the lower or working face of each block having the area of approximately one hundred and eighteen square inches. The current density may vary from twenty to twenty-five amperes per square inch of working face. For an electrode-block of this size and for the current density mentioned the shank should consist of a carbon rod six inches in diameter where a single rod is employed as conductor and support, or where two such rods are used the diameter of each should be four and one-fourth inches. It is of course understood that this example is given by way of illustration only and that the proportions of parts will be varied to correspond to the current used.

The expression "shank portion" is employed in the claims to indicate that portion of the electrode which constitutes the conductor and support, whether one or several carbon rods be used.

I claim—

1. An electrode for use with high current densities consisting of a carbon block constituting the working head, and a carbon shank portion constituting the conductor and support, said shank portion being suitably proportioned to said block and removably secured thereto, as set forth.

2. An electrode for use with high current densities consisting of a carbon block constituting the working head, a carbon shank portion constituting the conductor and support, said shank portion being removably secured to said block and suitably proportioned thereto, and a sheath of refractory material surrounding said shank, as set forth.

3. An electrode consisting of a carbon block constituting the working head, a carbon shank constituting the conductor and support, said shank being removably secured to said block, and a sheath of refractory material surrounding said shank and supported by said block, as set forth.

4. An electrode consisting of a carbon block constituting the working head, a carbon shank constituting the conductor and support, said shank being removably secured to said block, and a sheath of refractory material surrounding said shank and extending below the plane of the upper surface of said block, as set forth.

5. An electrode for use with high current densities consisting of a carbon block constituting the working head, and a plurality of carbon shanks removably secured to said block and suitably proportioned thereto, as set forth.

6. An electrode for use with high current densities consisting of a carbon block constituting the working head, a plurality of carbon shanks, said shanks being removably secured to said block and suitably proportioned thereto, and a refractory sheath surrounding each shank, as set forth.

7. An electrode consisting of a carbon block constituting the working head, a plurality of carbon shanks removably secured to said block, and refractory sheaths surrounding said shanks and supported by said head, as set forth.

8. An electrode consisting of a carbon block constituting the working head, a plurality of carbon shanks removably secured to said block, a common conductor, and connections between said shanks and said conductor, as set forth.

9. An electrode consisting of a carbon block constituting the working head, a carbon shank removably secured to said block, a conductor secured to said shank, and a refractory casing

surrounding the juncture of said shank and conductor, said casing having a greater cross-sectional area than the working head, as set forth.

10. An electrode consisting of a carbon block, constituting the working head, a plurality of carbon shanks removably secured to said block, conductors secured to said shanks, and a refractory casing surrounding the junctures of said shanks and conductors, said casing having a greater cross-sectional area than the working head, as set forth.

11. A carbon electrode having its lower active face provided with grooves to permit the escape of gases, said grooves deepening toward the periphery of the electrode, as set forth.

12. A carbon electrode having its lower active face in contact with the electrolyte provided with open grooves, whereby passages are afforded for the escape of gases, and the active electrode-surface is increased, as set forth.

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

CHARLES ERNEST ACKER.

Witnesses:
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