

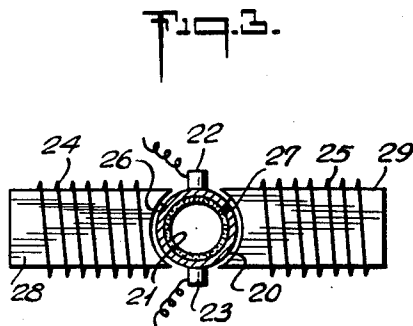
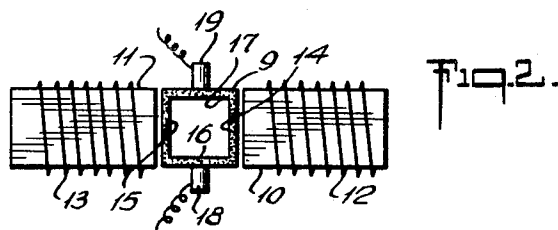
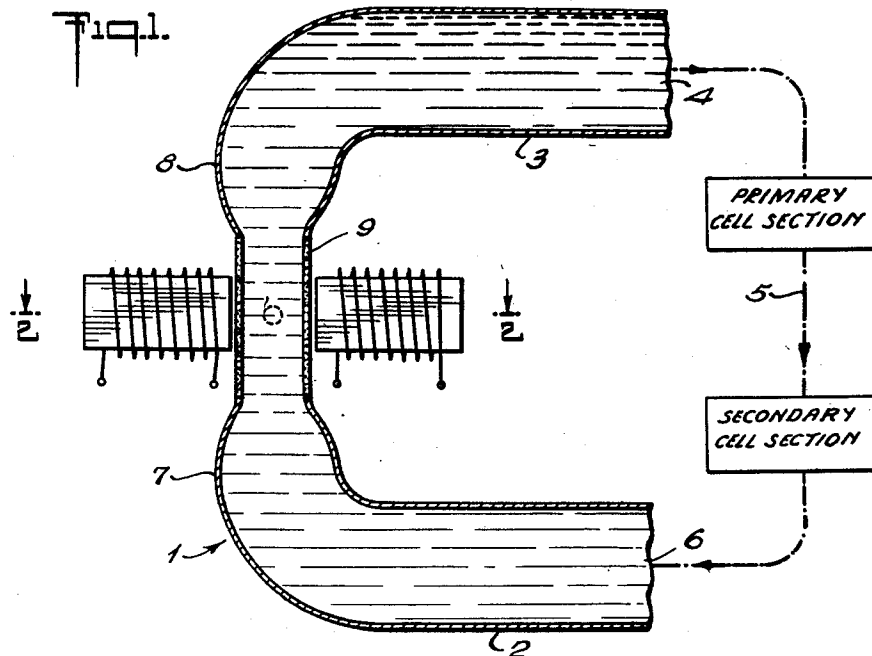
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DEVICES FOR THE PROPULSION OF MERCURY THROUGH A CONDUIT

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DEVICES FOR THE PROPULSION OF MERCURY
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This invention relates to devices for the propulsion of mercury through a conduit and is particularly concerned with propulsion of the mobile mercury cathode in its circulation through electrolytic cells.

Electrolytic cells employing mercury for a mobile cathode are commonly used for the electrolysis of alkaline metal chloride and the production of chlorine and allied products of amalgam decomposition. Such cells normally consist of a primary section in which the electrolysis takes place and the secondary section in which the amalgam formed in the primary section is decomposed. The mercury employed as the cathode passes in a closed circuit from the primary section into the secondary section and back again to the primary section. Propulsion of mercury in this path has heretofore been effected in a variety of ways.

Commonly, the mercury travelled by gravity from one section to the other and then was returned by a pump back to the original section. Such pumps acted to propel mercury by means of an impeller in the mercury driven by any common driving means. Such propelling has also been accomplished by injection. The operation is a continuous one and breakdowns in the system can be most serious. These have been too numerous with the prior art equipment, largely due to the limitations imposed upon the materials that could be employed for the propelling of mercury under the conditions imposed.

The continuous transporting of mercury in accordance with the invention is achieved by the use of electro-magnetic force, so that no moving part, or jet openings, are needed in or bordering the path taken by the mercury in its flow. The walls of the tube through which the mercury passes are imperforate, but the propelling of the mercury, while maintaining it free from contamination, as is particularly required in electrolytic cells, involves a number of special problems, even when the propelling force is electro-magnetic.

In the first place, the tube or conduit through which the mercury flows must be a good conductor of electricity and must be non-magnetic, but it must also be of a material devoid of anything which will amalgamate with the mercury. Thus, stainless steel is ruled out, for though it is non-magnetic and a good conductor of electricity, it nevertheless contains materials which will amalgamate with the mercury. Such amalgam, if introduced into the primary section of the cell, would cause the production of hydrogen with consequent explosive hazards. Obviously then, stainless steel or other alloys of a similar nature are ruled out where they engage the mercury.

In accordance with the invention, it has been found that graphite is not only a good conductor of electricity and non-magnetic, but it is also free of any material which amalgamates with mercury. Thus, tube or piping sections made of graphite can be employed at the position in the circuit where the electro-magnetic propulsive force is to be exerted on the mercury. Not only may such tube elements formed entirely of graphite be employed, but liners of graphite for conducting the mercury

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may be applied to tubes formed of stainless steel, or of other conducting and non-magnetic materials which could otherwise not be used.

Though graphite is the presently preferred material, platinum will work to at least a limited extent and can be employed as a complete tube, or as a lining for tubes of other material as just pointed out. The cost of platinum is, of course, another factor which limits its applicability for this purpose. Other materials can, of course, be used so long as they meet the requirements of being good conductors, being non-magnetic and being devoid of amalgamation with mercury.

The illustration in the accompanying drawing has been limited to a showing of the propulsion means, inasmuch as it is usable in connection with any electrolytic cell incorporating a mobile mercury cathode operating in a closed circuit. Thus, in such drawing,

Figure 1 is a vertical section through a portion of a conduit to which is applied electro-magnetic means for the propulsion of mercury without contamination.

Figure 2 is a section taken on line 2-2 of Figure 1 and looking in the direction of the arrows, and

Figure 3 is a view similar to Figure 2 of a somewhat modified form of the invention.

In Figure 1, a conduit for the transporting of mercury is illustrated at 1 and as having a lower inlet portion 2 and an upper outlet portion 3. The portions 2 and 3 may merely be conduits connected to the primary and secondary sections of an electrolytic cell, or may be those cell sections themselves. In either event, they will be of such material as to contain the mercury without in and of themselves contaminating it or amalgamating with it. The existence of a complete circuit is illustrated by the dot-dash lines and directional arrows emerging from the conduit portions 3 and 4, continuing along at 5 and returning into the conduit at 6.

The vertically extending portion of the conduit as here shown has portions 7 and 8 of diminishing cross sectional area whose reduced ends are joined with the ends of a conduit portion 9 of reduced cross sectional area. The portion 9 is here shown as having its walls formed entirely of graphite. Its ends are suitably joined with the reduced ends of the portions 7 and 8 of the conduit 1 to provide a continuous leak-proof path therethrough.

By reference to Figure 2, it will be seen that the portion 9 is square in cross section, which is the preferred configuration to enable the straight ends of cores 10 and 11 of electromagnets 12 and 13 to be brought up close to and parallel to a pair of opposite sides 14 and 15 of that portion. This produces maximum effectiveness of the magnetic field with respect to the mercury in the portion 9. There must be a space between the ends of those cores and the opposed outer surfaces of the sides 14 and 15, but that space should be kept at a minimum to avoid loss of strength of the magnetic field.

The remaining pair of opposite sides 16 and 17 of the portion 9 have contacts 18 and 19 of copper or other suitable material applied thereto, so that current from suitable leads, as indicated, can be passed through mercury. In effect, then, the mercury forms the armature of an electric motor, of which the electro-magnets form the field whereby the mercury is propelled along the tube.

As already indicated, a tube of square cross-section, and formed of graphite, is productive of the best results. Graphite is conductive, non-magnetic, and will not amalgamate with the mercury. The square cross-section enables the electro-magnets to be brought up in close proximity to the exterior surface and to lie at a uniform distance from that surface throughout their extent. However, tubes of other materials or combinations of materials may be employed, so long as they meet the criteria

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of being conductive, non-magnetic and will contain mercury without forming an amalgam.

One readily workable combination, though not as effective as pure graphite, is to make the tube out of stainless steel and line it interiorly with graphite. Here, however, as in other constructions, where a lining of graphite is applied to other materials, there will be a loss of electrical effect due to the joiner of the graphite and the stainless steel.

The cross section shown in Figure 3 not only illustrates the use of a section of conduit formed out of stainless steel with a graphite lining in a device for the propulsion of mercury, but, in addition, it illustrates the use of a conduit of circular cross section. The stainless steel portion of the conduit is illustrated at 20 and the graphite lining therefor is shown at 21. Contacts 22 and 23 are provided at opposite ends of one diameter across the conduit for passing electric current through the conduit and through the mercury contained thereby. Electro-magnets 24 and 25 are axially located at the ends of a diameter at right angles to that on which the contacts 22 and 23 are located.

In connection with the location of the electro-magnets, it is important to note that the inner faces 26 and 27 of their cores 28 and 29 are given a complementary curve to that of the exterior of the stainless steel conduit portion. These curved faces of the electro-magnets hug the exterior of the stainless steel conduit, leaving only a small air space between them and the exterior of the conduit and they extend around beyond the ends of the internal diameter of the conduit. Thus, the mercury within the conduit, though not subjected to the electro-magnet effect as fully as is the case where the conduit portion is square in cross section, is nevertheless subjected to the fullest effect that can be imparted when the conduit is round in cross section.

The round cross section conduit portion has the advantage of being more easily joined to other conduit portions bringing the mercury to and from it, than is the case where the conduit portion is square in cross section. However, the problem of making a tight joint, using a conduit portion which is square in cross section is merely more difficult than when a round conduit is employed. This difficulty is, however, far outweighed by the advantages in operation where a conduit portion of square cross section can be employed. The latter provides a considerably more efficient propulsion of mercury.

While in the foregoing, the presently preferred and several alternate embodiments of the invention have been described, it is to be appreciated that other effective materials and variations of the construction will suggest themselves to those skilled in the art. These and other changes may be made in the above construction and different embodiments of the invention could be made without departing from the scope thereof. It is therefore intended that all matter contained in the above description, or shown in the accompanying drawing, shall be interpreted as illustrative and not in a limiting sense.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In electrolytic mercury cell construction having primary and secondary sections, a conduit for confining the flow of mercury between the secondary and primary sections of such cell, said conduit being formed out of material which will not amalgamate with mercury, a system for propelling mercury through said conduit which comprises, said conduit having a portion formed of graphite, a pair of electro-magnets on one pair of opposite sides of said portion, and a pair of electrical contacts on another pair of opposite sides of said portion for passing electric

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current transversely through said portion and through mercury contained therein at a position closely adjacent the position of said electro-magnets and transversely with respect to the magnetic field established thereby.

2. In electrolytic mercury cell construction having primary and secondary sections, a conduit for confining the flow of mercury between the secondary and primary sections of such cell, said conduit being formed out of material which will not amalgamate with mercury, a system for propelling mercury through said conduit which comprises, said conduit having a portion formed of graphite and of square cross-section, a pair of electro-magnets on one pair of opposite sides of said portion and mounted with their end faces closely adjacent the exterior surface of said portion leaving a small air space therebetween, and a pair of electrical contacts engaged with the exteriors of the other pair of opposite faces of said portion for passing an electric current transversely through said conduit and transversely with respect to the magnetic field established by said electro-magnets.

3. In electrolytic mercury cell construction having primary and secondary sections, a conduit for confining the flow of mercury between the secondary and primary sections of such cell, said conduit being formed with an interior surface of material which will not amalgamate with mercury, and a system for propelling mercury through said conduit, said system including a portion of said conduit formed of stainless steel, an interior lining of graphite for said portion, a pair of electromagnets located closely adjacent one opposed pair of opposite exterior faces of said portion and a pair of electric contacts secured to another pair of opposed exterior faces of said portion at positions at right angles to the positions of said electro-magnets for passing an electric current transversely through said conduit and transversely with respect to the magnetic field established by said electro-magnets.

4. In electrolytic mercury cell construction having primary and secondary sections, a conduit for confining the flow of mercury between the secondary and primary sections of such cell, said conduit being formed out of material which will not amalgamate with mercury, a system for propelling mercury through said conduit which comprises, a portion of said conduit having at least one pair of opposite walls formed of graphite, a pair of electrical contacts engaged with the exteriors of said graphite walls, a pair of electro-magnets on the other pair of opposite sides of said portion, said other pair of opposite sides being formed for the establishment of an electromagnetic field therethrough, said electrical contacts being located for passing electric current transversely through said portion and through mercury contained therein at a position closely adjacent the position of said electro-magnets and transversely with respect to the magnetic field established thereby.

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