This invention relates to an apparatus for generating electrical potential, and more particularly it relates to such an apparatus for the generation of current directly from heat due to the combination of dissimilar materials, without the use of mechanical or magnetic devices. An object of the invention is the provision of a thermo-chemical means of generating potential with high efficiency.

In the prior art the various devices applied for generating current directly from a source of heat have been purely experimental and of limited efficiency. The devices are such as those employing thermo-electric contacts and those using the frictional effect of gases or vapors. The present invention utilizes a principle of operation which is entirely novel; it employs the heat of formation of a compound or alloy of dissimilar materials; that is, one between certain electro-positive materials and a contacting relatively electro-negative material.

I have found that when certain electro-positive materials, such as potassium and sodium are placed in contact with a relatively electro-negative material, such as mercury, and an amalgam is so formed, a potential is generated at the point of contact, corresponding to the energy liberated by the reaction in forming the amalgam. To generate a continuous current by alloying mercury and an alkali metal by this means the two materials are brought into contact, forming an amalgam, the two materials are then separated by distillation of the mercury which is then condensed and reamalgamated with a body of alkali metal, the whole in a continuous cycle within a closed vessel at low pressure. By this invention a means is provided by which the product of the reaction, as that of mercury or its equivalent with an alkali metal, is thermally decomposed and the mercury condensed and then used to form an amalgam which is then decomposed and so on in a cycle to generate a current by repeated contact reaction.

While mercury is selected as a desirable material, other elements such as bismuth or their amalgams can be used satisfactorily. As the relatively electro-positive material, potassium has been found to be a very practicable element for this application; but other alkali metals such as rubidium, cesium, sodium, etc., can be used, as I have experimentally demonstrated.

The device and its method of operation may be best understood by reference to the following description of the accompanying drawing illustrating an embodiment of the invention, showing a sectional view thereof in which I represents a highly evacuated vessel of refractory glass partially thermally insulated by Is, and containing in chamber 2, an amalgam of mercury and potassium 3. Above chamber 2, is manifold 5, which projects into metal tube 8, the lower end of which is tapered and has a small orifice at the bottom. Surrounding and extending below tube 8, is chamber 2, and, connecting chambers 2 and 2a, are conduit 10 having a trap therein 11, and lower conduit 12. Connecting with manifold 5, is inlet pipe 6, controlled by a valve for introducing the mercury amalgam. In chamber 2, a body of potassium or a weak amalgam 3a, which is maintained at an approximate level with amalgam 3 in chamber 2, by conduit 13. Cooling systems 7 and 9 are placed about portions of the vessel 1. Tube 8 and potassium body 3a, are used as terminals for connection in an external electric circuit. At 1s is a nipple through which vessel 1 is evacuated to as high a degree as is practicable.

As heat is applied to the mercury-potassium amalgam 3, in chamber 2, mercury is distilled from the amalgam, passing through manifold 5. The temperature of the amalgam in the condenser side is maintained below the vaporizing temperature of mercury. In the area surrounded by cooling element 7, the vapors are condensed and the metals precipitated flow into metal tube 8, and thence through the orifice, which is close to the top of potassium body 3a, making electrically conductive contact between the tube and the potassium body and there forming an amalgam with potassium body 3a. The heat generated in the reaction forming the amalgam is carried off by cooling member 9, the cooling fluid being applied only in sufficient quantity to dissipate the heat generated by...
the combination between the alkaline metal and the mercury body. When the mercury flowing out of the metal nozzle makes contact with the potassium or weak amalgam in chamber 2, an amalgamation of the metals is effected and a potential is there generated which is transmitted through the circuit comprising the precipitating metal, the metal tube, the amalgam 3, in the reaction chamber, and the external circuit represented by terminals 13 and 14.

The amalgam or reaction product formed in chamber 2, raises the level of the liquid in that chamber so that it gravimetrically flows back through conduit 12 to boiler chamber 2. The temperature difference between the two amalgams also serves to promote the flow of the newly formed amalgam to that in the heated chamber. Trap 11 serves to prevent the passage of vapor from chamber 2, to chamber 2 and likewise serves to prevent the passage of the product of distillation from chamber 2 to chamber 2. The exhaustion of the entire apparatus to the vapor pressure of the materials contained therein serves to maintain at a minimum the energy necessary for the vaporization of the materials. In some cases it might be desirable to add an inert gas such as helium to assist in cooling. The temperature of the first condenser should not be brought to the point at which the potassium solidifies; it must be maintained in a liquid state.

What I claim is:

1. An apparatus for generating electrical potential comprising a vessel composed of an electrically insulating material partially thermally insulated, and having a vaporizing chamber containing an amalgam, another chamber containing another body of amalgam, a manifold for discharging metal vapor from said vaporizing chamber, means for condensing said vapor above said second mentioned chamber, means, comprising a metal tube having a relatively small orifice adjacent the second mentioned body of amalgam, for discharging said condensed vapor into contact with the second mentioned body of amalgam, a conduit for the passage of amalgam from the second mentioned chamber to the vaporizing chamber, means for connecting the contents of the second mentioned chamber and the metal tube in an external conductive circuit and means for heating the content of the first mentioned chamber.

2. An apparatus for generating electrical potential comprising a vessel composed of an electrically insulating material partially thermally insulated and having a vaporizing chamber containing a body of amalgam, another chamber containing another body of amalgam, a manifold for conducting metal vapor from said vaporizing chamber, means for condensing said vapor above said second mentioned chamber, means, comprising a metal tube having a relatively small orifice adjacent the second mentioned body of amalgam, for discharging said condensed vapor into contact with the second mentioned body of amalgam, a conduit for the passage of amalgam from the second mentioned chamber to the vaporizing chamber, means for connecting the contents of the second mentioned chamber and the metal tube in an external conductive circuit, and means for heating the content of the first mentioned chamber, and means for cooling the content of the second mentioned chamber.

In testimony whereof, I, SAMUEL RUBEN, have signed my name to this specification, this 16th day of September, 1929.

SAMUEL RUBEN.