To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, Orange, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Reversible Galvanic Batteries, of which the following is a description.

My invention relates to reversible galvanic batteries of the type employing an alkaline electrolyte and insoluble electrolytically-active materials; and the invention relates particularly to the oxidizable element—namely, the element employing an active material which is oxidized on discharge and reduced during the charging operation.

The invention consists in the use of cobalt oxid, preferably mixed with metallic mercury or with metallic mercury and copper or silver, whereby a great proportion of the cobalt oxid is kept in electrical contact with the electrode and made electrolytically active in an alkaline solution to form the oxidizable element on discharge.

The invention also consists in the combination of such an element with a suitable depolarizer furnishing oxygen on discharge in an alkaline electrolyte to form a complete reversible galvanic battery.

In order to produce the new element, I prefer to proceed substantially as follows: Dried oxalate of cobalt is first produced in any suitable way and is ignited and kept at a low temperature in the air until it has been wholly decomposed to form the anhydrous oxid of cobalt. This oxid is then mixed with preferably about fifteen per cent. of precipitated oxid of mercury if an electrode is to be obtained composed of cobalt and mercury, or, if desired, it may be mixed, preferably, with about twenty-five per cent. of finely-divided metallic copper and six per cent. of precipitated oxid of mercury if the resulting electrode is to be formed of cobalt and a combination of copper and mercury. These proportions of course may be varied; but those indicated give good results. I find, in fact, that by increasing the proportion of mercury or of mercury and copper a larger proportion of the cobalt is rendered active; but the increase in efficiency is secured at a sacrifice of lightness and economy. Silver may also be employed in place of the copper; but it possesses the objection of being too expensive at the present time for economical use.

The mixture of oxid of cobalt and oxid of mercury or of oxid of cobalt, metallic copper, and oxid of mercury is then mixed thoroughly, formed into briquets, and utilized in any desired manner, preferably by being supported in perforated nickel-plated pockets or receptacles, which in turn are crimped in position within plates or grids, as I have described in patents already granted to me.

An electrode containing a mixture of cobalt 65 and mercury or of cobalt, mercury, and copper or silver is preferably employed in an alkaline solution of, say, twenty per cent. of potassium hydroxid in water opposed to a depolarizing element containing nickel hydridox as the active material mixed with foliated or flake graphite. When such a combination has been charged and recharged several times, its average voltage is about 1.10 volts. When such a combination is in a fully charged condition, the nickel hydroxid is raised to a very high state of oxidation and the cobalt is reduced, so far as its active particles are concerned, to the metallic state. On discharging the nickel hydroxid reverts 80 to a lower condition of oxidation, while the metallic cobalt is oxidized. Owing to the relative ease, as compared to cobalt, with which mercury and copper reduce, the added mercury or copper, or silver, if used, will be reduced to the metallic state when the battery is first charged, so as to procure good electrical contact between the active cobalt particles. Since the cobalt on discharge oxidizes much more readily than either mercury, copper, or silver, the latter materials remain in metallic form, and their presence serves wholly to assist electrical conduction between the particles of the active material.

Although I prefer to add a readily-reducible metal, like mercury, copper, or silver, or a combination thereof, to the cobalt for the purpose of maintaining electrical contact between the active materials, it will be of course understood that any insoluble conducting material, preferably in flake form, such as flake graphite, can be used for maintaining the cobalt particles in electrical contact.
Having now described my invention, what
I claim is—

1. An oxidizable element for a reversible
galvanic battery employing cobalt, which is
oxidized on discharge, substantially as set
forth.

2. In a reversible galvanic battery employ-
ing an alkaline electrolyte, an oxidizable ele-
ment therefor employing cobalt, which is
oxidized on discharge, substantially as set
forth.

3. An oxidizable element for a reversible
galvanic battery employing cobalt as the ac-
tive material, and a more readily reducible
metal or combination of such metals added
thereto for preserving electrical contact be-
tween the active particles, substantially as
set forth.

4. In a reversible galvanic battery, an ox-
idizable element employing cobalt as the ac-
tive material, mixed with metallic mercury
for preserving electrical contact between the
active particles, substantially as set forth.

5. A reversible galvanic battery employing
cobalt as the active material, mixed with me-
tallic mercury and another readily-reducible
metal for preserving electrical contact be-
tween the active particles, substantially as
set forth.

6. In a reversible galvanic battery, an ox-
idizable element therefor employing cobalt as
the active material, mixed with metallic mer-
curry and metallic copper for preserving ele-
trical contact between the particles of active
material, substantially as set forth.

7. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode, of an
oxidizable electrode employing cobalt as the
oxidizable material on discharge, substan-
tially as set forth.

8. In a reversible galvanic battery employ-
ing an alkaline electrolyte, the combination
with a depolarizing-electrode, of an oxidiza-
able electrode employing cobalt as the oxidi-
able active material on discharge, substan-
tially as set forth.

9. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode, of an
oxidizable electrode employing cobalt as the
oxidizable material on discharge, and a read-
ily-reducible metal mixed with the cobalt for
preserving electrical contact between the ac-
tive particles, substantially as set forth.

10. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode, of an
oxidizable electrode employing cobalt as the
oxidizable material on discharge, and me-
tallic mercury mixed with the cobalt for pre-
serving electrical contact between the active
particles, substantially as set forth.

11. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode, of an
oxidizable electrode employing cobalt as the
oxidizable material on discharge, and me-
tallic mercury and copper mixed with the co-
balt for preserving electrical contact between
the active particles, substantially as set forth.

12. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode em-
ploying nickel hydroxid as the active mate-
rial, of an oxidizable electrode employing cobalt
as the oxidizable material on discharge, and
a readily-reducible metal mixed with the cobalt
for preserving electrical contact between the
active particles, substantially as set forth.

13. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode em-
ploying nickel hydroxid as the active mate-
rial, of an oxidizable electrode employing cobalt
as the oxidizable material on discharge, and
metallic mercury mixed with the cobalt for
preserving electrical contact between the active
particles, substantially as set forth.

14. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode em-
ploying nickel hydroxid as the active mate-
rial, of an oxidizable electrode employing cobalt
as the oxidizable material on discharge, and
metallic mercury mixed with the cobalt for
preserving electrical contact between the active
particles, substantially as set forth.

15. In a reversible galvanic battery, the com-
bination with a depolarizing-electrode em-
ploying nickel hydroxid as the active mate-
rial, of an oxidizable electrode employing cobalt
as the oxidizable material on discharge, and
metallic mercury and copper mixed with the
cobalt for preserving electrical contact be-
tween the active particles, substantially as
set forth.

This specification signed and witnessed this 10th day of November, 1902.

Witnesses:
FRANK L. DYER,
J. F. RANDOLPH.

THOS. A. EDISON.