

No. 775,597.

PATENTED NOV. 22, 1904.

H. R. CASSEL.

PROCESS OF EXTRACTING GOLD FROM ORES.

APPLICATION FILED MAY 22, 1903.

NO MODEL.

FIG. 1.

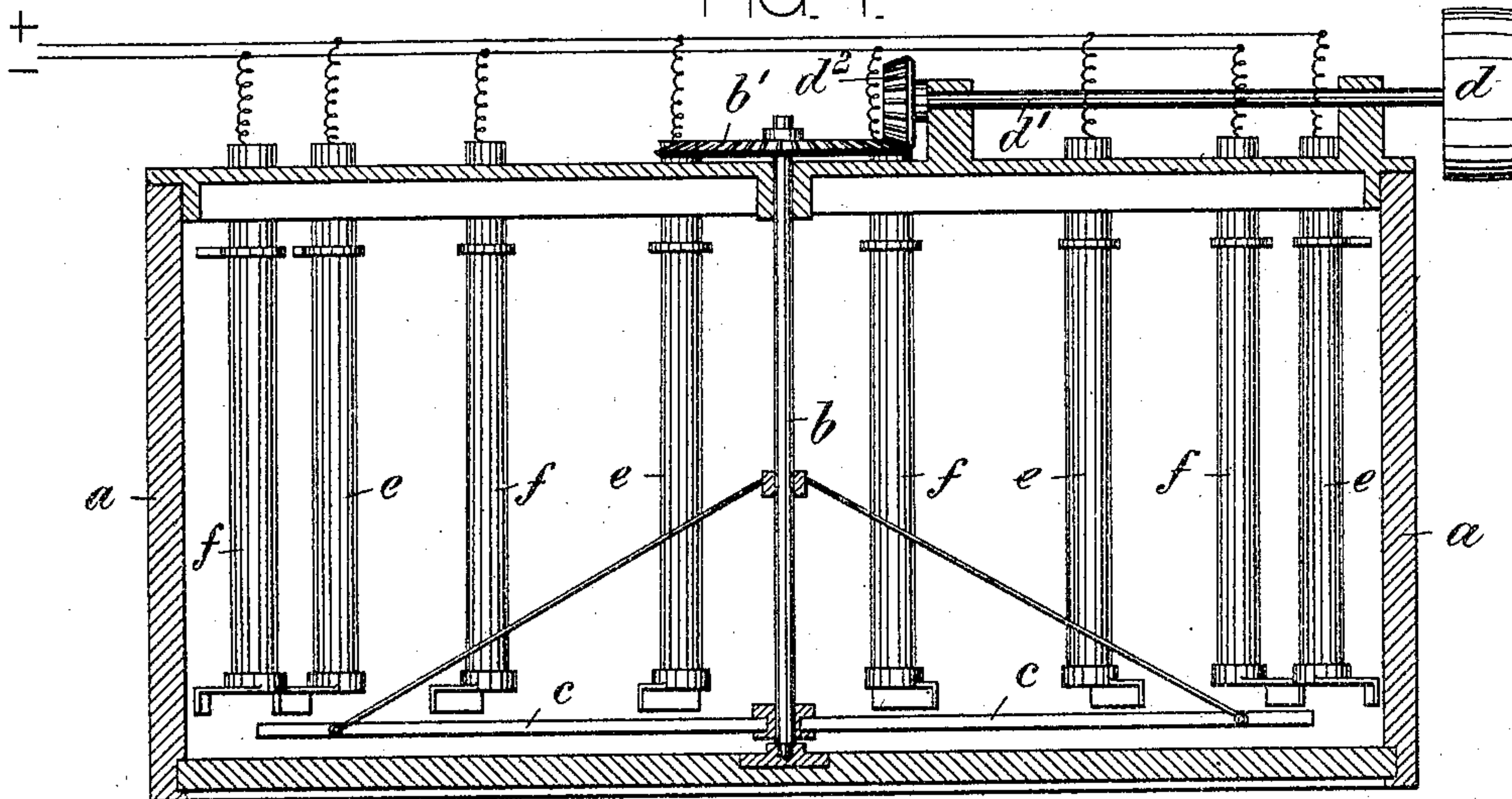
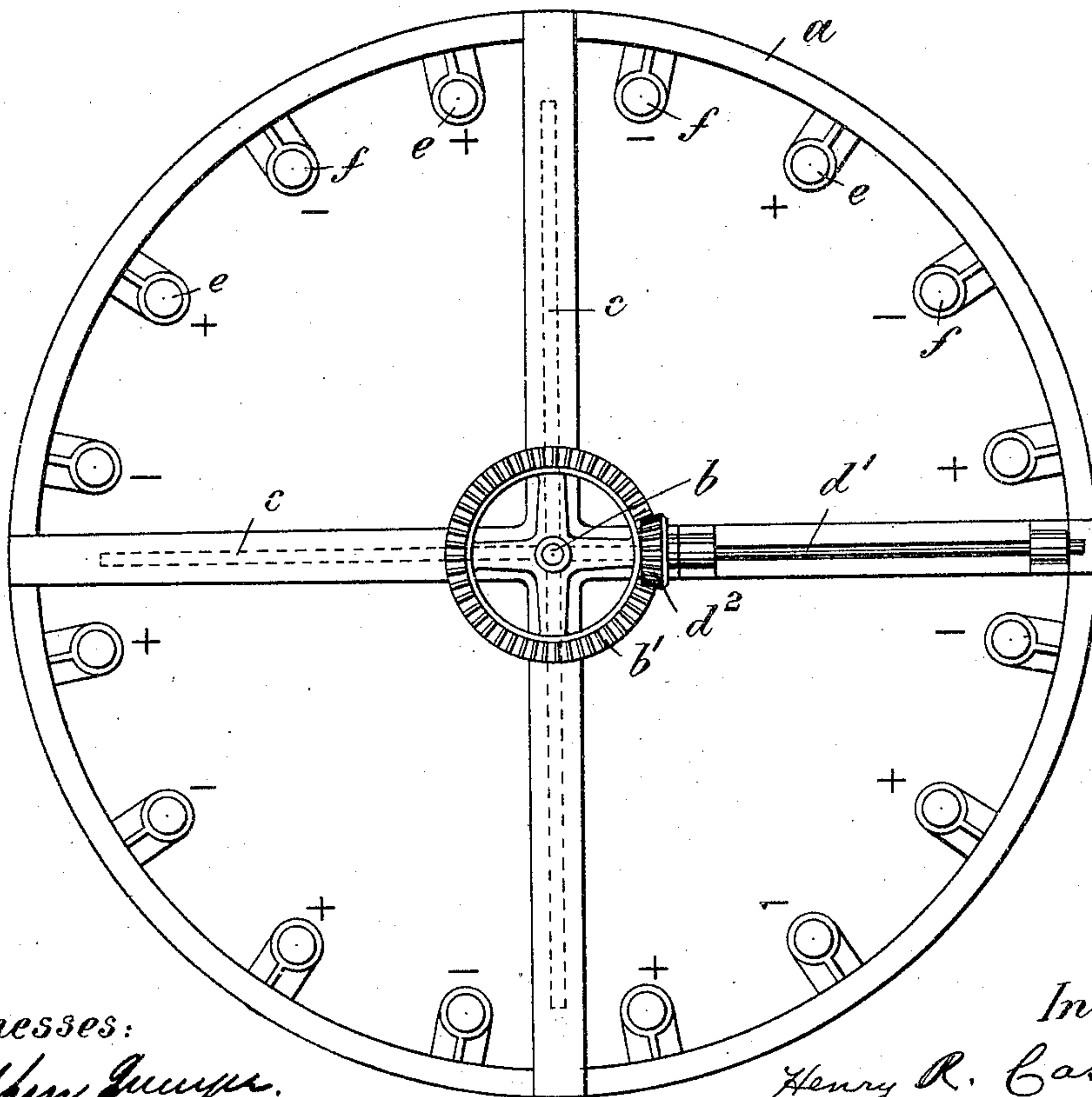


FIG. 2.



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Arthur Guyma.
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UNITED STATES PATENT OFFICE.

HENRY R. CASSEL, OF LONDON, ENGLAND.

PROCESS OF EXTRACTING GOLD FROM ORES.

SPECIFICATION forming part of Letters Patent No. 775,597, dated November 22, 1904.

Application filed May 22, 1903. Serial No. 158,223. (No specimens.)

To all whom it may concern:

Be it known that I, HENRY R. CASSEL, a citizen of the United States, residing at London, England, have invented certain new and useful Improvements in Processes of Extracting Gold from Ores, of which the following is a specification.

The object of my invention is to provide means for readily dissolving and extracting precious metals from refractory ores, such as tellurids and sulfids or slimes containing them, without previous roasting. The roasting of the ores is unnecessary.

The process is applicable to higher-grade as well as low-grade ores and may be carried out in any ordinary agitation-vat containing a number of carbon anodes and cathodes.

In the accompanying drawings, Figure 1 is a vertical cross-section of an apparatus for carrying my invention into effect, and Fig. 2 a plan of the same.

The letter *a* represents a round wooden tank provided with a vertical shaft *b*, carrying a stirrer *c*. The shaft *b* may be driven from pulley *d* by a shaft *d'* and bevel gear-wheels *d'' b'*.

In the vat *a* are arranged a series of carbon rods or plates *e f*, which constitute anodes and cathodes, respectively. I prefer to arrange these rods alternately and near the periphery of the vat, as shown in Fig. 2. The anodes and cathodes are of course connected with the respective poles of a dynamo.

The pulverized ore is converted into a pulp by mixing it with an electrolyte consisting of water containing either a cyanid and a bromid alone or a cyanid, a bromid, and a chlorid—for instance, chlorid of sodium or other suitable salts. Bromates and chlorates may also be added.

Different ores require variations in the composition of the electrolyte and in the current. An electrolyte of the following composition and amount may usually be employed with good results for the treatment of one ton of ore: one ton of water, one hundred pounds of sodium chlorid, three pounds of sodium bromid, two pounds of potassium cyanid. If the chlorid is omitted and bromid alone is added to the cyanid, the quantity of the bro-

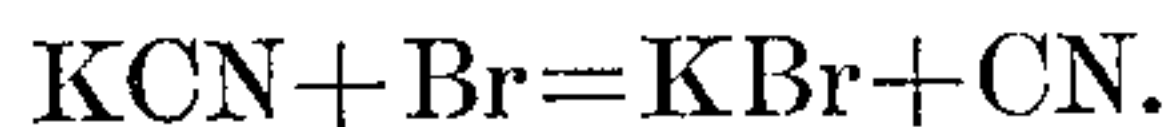
mid must be increased to make the electrolyte sufficiently conductive. I have found that the presence of a bromid is very desirable to effect a high extraction of over ninety per cent., and when omitted the results are negative. The chlorid is added mainly to render the electrolyte more conductive. The pulp thus prepared is charged into the agitating-vat *a* and is kept in constant agitation, while simultaneously a current of electricity is passed through it. I use about one hundred amperes per ton of ore and at a high-current density exceeding ten amperes and preferably about forty amperes per square foot of anode-surface.

By virtue of the passage of the current through the electrolyte a series of complex reactions ensue and powerful solvents for the gold are formed, which convert the precious metal into a soluble cyanid of gold.

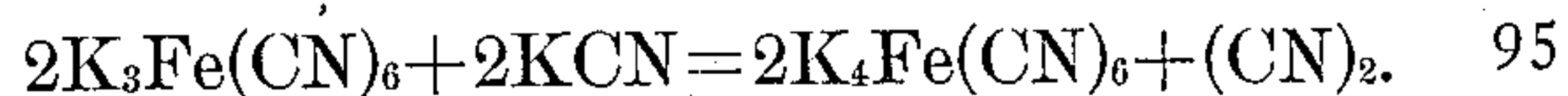
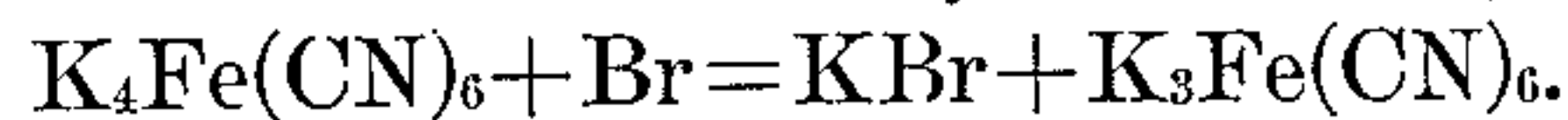
Reactions: The chief solvent consists of nascent cyanogen in the presence of free cyanid. This substance is formed by electrolysis in several ways, as the equations will show. Sulfids and tellurids always contain acid salts, due to the decomposition of these minerals. Thus is supplied the necessary acid and iron salt, as follows:



At the anode chlorin, bromin, and cyanogen are generated. The chlorin and bromin being in the nascent state react with cyanid by direct substitution, as follows:



The ferrocyanid thus formed is converted into ferricyanid by the halogen, and further reaction with cyanid produces nascent cyanogen.



Nascent cyanogen is therefore being gradually and continuously generated by electrolysis in the presence of free cyanid.

An ore of about the following composition

is well adapted for treatment by my process: silica, sixty-four per cent.; alumina, 27.5 per cent.; lime, one per cent.; iron oxid, 3.5 per cent.; iron sulfid, three per cent.; manganese
5 oxid, 0.5 per cent.; magnesia, gold, tellurium, 0.5 per cent.

The extraction is more rapid and complete and more metal is dissolved than would be the case were the current not employed, the in-
10 creased extraction in some instances amounting to over forty per cent. Notwithstanding the effect of the electrolysis, practically all the haloid salt or salts previously added will be found unimpaired at the end of the opera-
15 tion, the cyanid alone suffering any appreciable decomposition.

To recover the dissolved gold and also the salts from the pulp, I now separate the solu-
20 tion from the ore by filter-pressing or otherwise. The gold is then precipitated on zinc or by any other method. The solution after being freed from the gold contains the haloid salt or salts previously added to the electro-
25 lyte. It may therefore be successively employed on other batches of ore by merely adding sufficient cyanid to replace the cyanid consumed during treatment. The extraction is generally complete in about twelve hours.

Ores that are readily leachable may be treat-
30 ed by percolation with the above-described electrolyzed solution.

It will be seen that by my invention I generate electrolytically-powerful solvents, which gradually and continuously dissolve the gold
35 and transform it into a soluble cyanid which is retained in solution. From this solution the dissolved metal can easily be recovered by any of the known methods of precipitation.

It will be observed that I employ a high cur-
40 rent density. In fact, with low current densities my advantages would not result, for the various compounds would not be so completely decomposed and the chemical reactions would not be so rapid. Besides, with an ordinary
45 low current the gold would be precipitated upon the cathode, which would be fatal to my process. By the term "high current density" found in the claims, however, I do not mean to be limited to the density stated above, for
50 it is apparent that the density may be varied according to the nature of the ore and at the will of the operator; but, generally speaking, no density is to be employed which will cause a substantial deposit of gold from my electro-

lyte on any kind of a cathode. In practice I 55 use a substantially neutral solution.

What I claim is—

1. A process for the extraction of precious metals, which consists in gradually and con-
60 tinuously generating, by electrolysis at a high current density exceeding ten amperes per square foot of anode-surface, nascent cyano-
gen in the pulp containing a cyanid and a halogen salt, simultaneously agitating the pulp, dissolving and converting the precious
65 metals into soluble cyanids, and retaining them in solution, substantially as specified.

2. A process for the extraction of gold from unroasted pulverized ore, which consists in
70 agitating the pulverized ore with an electrolyte containing a cyanid, a bromid and a chlorid of a suitable soluble base, and simultaneously electrolyzing at a high current density ex-
ceeding ten amperes per square foot of anode-
75 surface, the pulp to dissolve the precious metal and convert it into soluble cyanid which is retained in solution, substantially as specified.

3. A process for the extraction of gold from pulverized ore, which consists in agitating the
80 ore with a solution containing a cyanid and a haloid salt, gradually and continuously transforming the gold into a soluble cyanid by passing a current of electricity at a high density exceeding ten amperes per square foot of
85 anode-surface through the pulp, recovering the haloid salt by separating the solution from the ore, and precipitating the gold therefrom, substantially as specified.

4. A process for the extraction of gold from pulverized ore, which consists in agitating the
90 ore with a solution containing a cyanid and a haloid salt, gradually and continuously transforming the gold into a soluble cyanid by passing a current of electricity at a high density exceeding ten amperes per square foot of
95 anode-surface through the pulp, recovering the haloid salt by separating the solution from the ore, precipitating the gold therefrom, adding cyanid to the recovered solution, and subsequently reusing such solution, substantially
100 as specified.

Signed by me at London, England, this 12th day of May, 1903.

HENRY R. CASSEL.

Witnesses:

H. D. JAMESON,
F. L. RAND.