No. 864,597. PATENTED AUG. 27, 1907.

A. J. F. DE BAVAY.

PROCESS OF SEPARATING ZINC BLENDE BY FLOTATION.

APPLICATION FILED DEC. 19, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

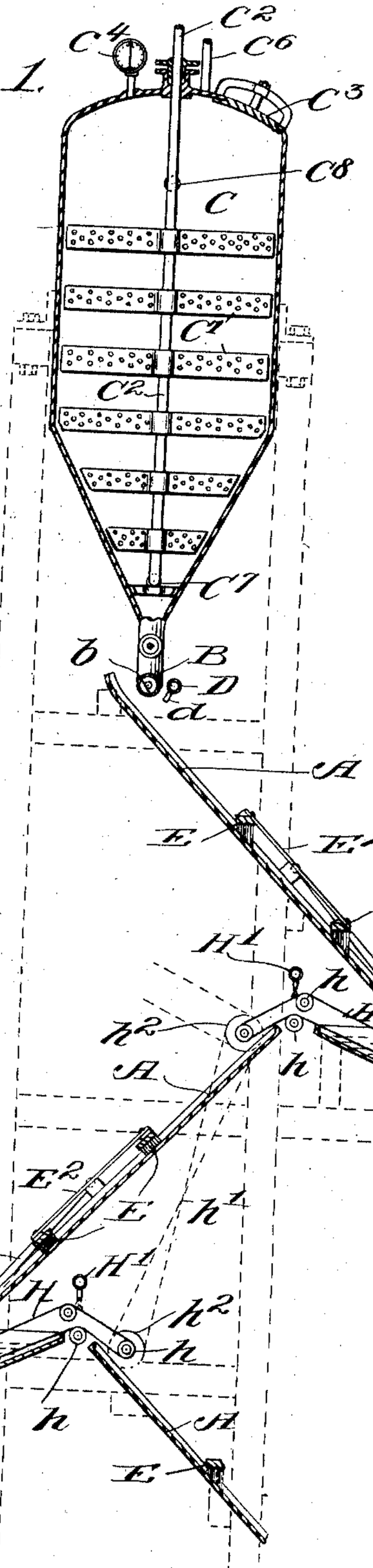


Fig. 3

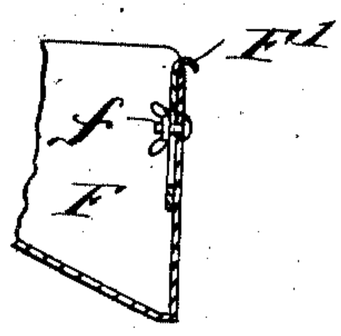
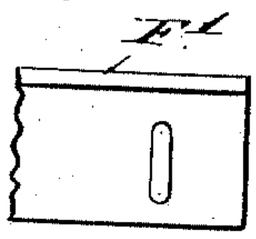


Fig. 4.



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2 SHEETS—SHEET 2.

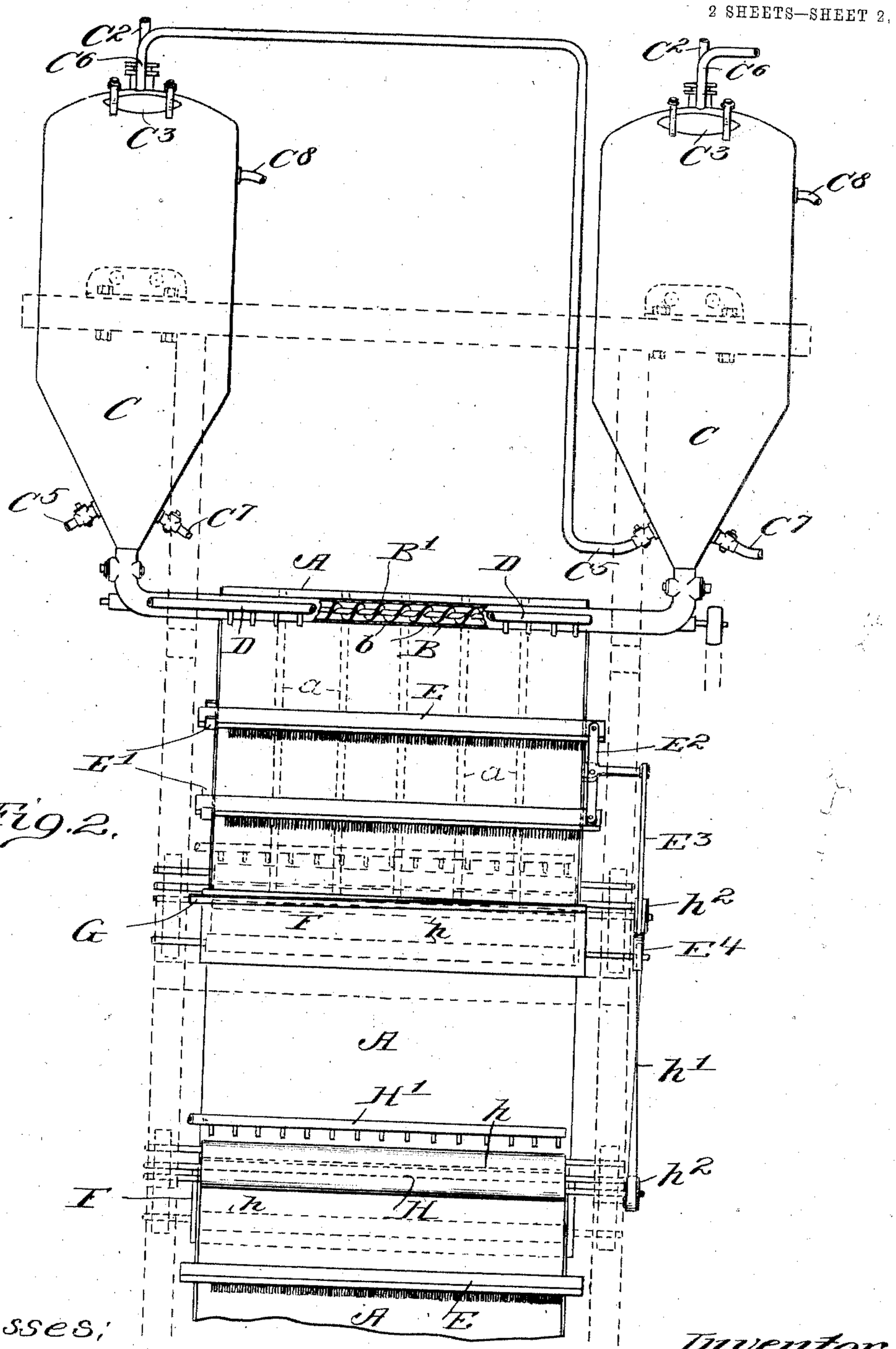

Fig. 2.

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UNITED STATES PATENT OFFICE.

AUGUSTE JOSEPH FRANÇOIS DE BAVAY, OF KEW, VICTORIA, AUSTRALIA.

PROCESS OF SEPARATING ZINC-BLENDE BY FLOTATION.

No. 864,597. Specification of Letters Patent. Patented Aug. 27, 1907.

Application filed December 19, 1904. Serial No. 237,655.

To all whom it may concern:

Be it known that I, AUGUSTE JOSEPH FRANÇOIS DE BAVAY, a subject of the King of Great Britain and Ireland, residing at "Florimel," Gellibrand street, Kew, in the British State of Victoria, Commonwealth of Australia, brewer and chemist, have invented a certain new and useful Process of Separating Zinc-Blende by Flotation, of which the following is a specification.

This invention consists in an improved process for separating zinc blende particles from ores, tailings and concentrates, in which they are found or with which they are associated. I observed that with ores, tailings or concentrates which were apparently suitable for treatment, an unsatisfactory separation was obtained and this I discovered was caused by the surface of the zinc blende particles being coated or associated with carbonates or other substances.

The separation is effected by first freeing the zinc blende particles from the carbonates and other impurities found associated with, or coating them, by submitting the ore tailings or concentrates in a pulverized condition to the action of carbonates of ammonia, bi-carbonates of sodium or bi-carbonates of potassium in solution or to carbonic acid gas preferably in a closed vessel or to the action of any other re-agent which will bring about the separation of the coating or covering from the zinc blende particles or to trituration and afterwards by thoroughly washing out the said impurities and the slimes and afterwards distributing the pulverized ore tailings or concentrates with water evenly upon the upper end of an inclined table the lower part of which delivers to a trough or well wherein the zinc blende particles are readily separated from the remaining particles by the zinc blende floating over the water surface to a suitable trough, while the remaining substances sink in the water and may either be collected therein or be carried off for further similar treatment.

The term "water" is used to mean and include water or other liquid on which particles of zinc blende are capable of flotation. The ore (which term is hereinafter used to mean and include ores, tailings and concentrates, in which zinc blende is found or with which it is associated) to be treated or the soild particles thereof must be in such a pulverized condition that it will pass through a mesh of from about 40 to 80 to the lineal inch, and the sifted ore must be freed from the carbonates and other impurities, as above indicated, before the separation of zinc blende by flotation can be advantageously effected.

I have found that the sulfids of zinc, lead and silver as they exist in the ore are generally coated with carbonates of zinc, iron and manganese and other matter and that it is impossible to separate by flotation in such a condition more than a very small proportion of the zinc blende particles from the gangue and even then the floatable portion contains a large proportion of the gangue, and hence it becomes necessary to treat the ore as herein described to prepare it for separation by flotation.

In working this process the ore is first sifted, as hereinbefore described, then it is delivered to a vessel containing water about equal in quantity to the ore bulk and such vessel is fitted with stirring appliances and preferably, if gas is to be used, should be capable of being hermetically sealed after the charge is within the vessel. The ore is then treated either— (*a*) By soaking the ore in a weak solution of carbonate of ammonia, bi-carbonate of soda, or bi-carbonate of potash, say from 1/2 to 10 per cent solution and afterwards washing out as hereinbefore described. (*b*) By passing carbonic acid gas through the pulverized wet ore, either in an open or preferably a closed vessel and then washing out as hereinbefore described. (*c*) By the use of any other re-agent which will bring about the separation of the coating or covering from the zinc blende particles and washing out as hereinbefore described. (*d*) By trituration or friction and washing out as hereinbefore described.

The strength of solution required, the sufficiency of the washing out, the quantity of carbonic acid gas to be used, the time required for the application of such solution or gas, and the extent of friction or trituration necessary can be easily ascertained by a few trials, but I have found that a one per cent solution or an equivalent quantity of carbonic acid gas even though not under pressure, especially if assisted by agitation or stirring, will in the space of about an hour effect the required cleansing. One simple method of ascertaining when the ore is ready for separation by flotation is to take a small sample, place it in a flat bottomed plate; pour a little water on it, hold the plate at an angle of 45°, or thereabouts, to the horizontal, when, if the ore is ready for further treatment, particles of zinc blende or other sulfids will be seen floating on the top of the water.

The ore having been treated and washed as described, is now mixed with water to bring it to a thin pasty condition in order that upon its being fed evenly to the top of an inclined surface it will be carried by the water in a thin film onto the surface of a trough or well of water to be used for the purposes of flotation, such stream being just sufficient to carry the ore in such thin film and to carry the floating particles over the surface of the water in such trough or well and into a suitable receptacle. Further such thin film of ore is delivered onto the surface of the water in such a manner and direction as to allow the particles of zinc blende to float and all or most of the remaining particles

to sink therein and be collected in such trough or well. I find that when this process is used a large proportion of the zinc blende can be floated over the surface of the water in such trough or well and can be collected in one receptacle, while the whole or almost the whole of the sand and other substances with which it is associated sink in the water in such well whence they are collected. In practice as a result of my process a very rich concentrate has been produced containing as much as 53.2 per cent of zinc.

If the separation desired (which can be determined by considering the assay value of the ore) be not effected by the first operation it is obvious that the process can and should be repeated, that is to say, the sand and other substances which have sunk, as aforesaid, in the water in such well should be again treated by this process until considerations of expense render further treatment undesirable.

An apparatus suitable for my flotation process will be found described in my application for Patent No. 237,585, filed December 19, 1904. In order that the present process may be clearly understood I will briefly describe such apparatus herein in connection with the accompanying drawings, in which:

Figure 1 is a sectional side view of an apparatus constructed according to my invention; Fig. 2 is a front view of the same; Fig. 3 is a broken sectional view of a portion of a trough, showing the application of the adjustable lip thereto; and, Fig. 4 is a broken detail view of said lip.

The apparatus consists, in the first place, of an inclined surface or table A suitably erected, supported and constructed so that it can be adjusted at an angle to the horizontal or, if fixed, supported at an angle of about 45° thereto, somewhat as shown, and preferably made of or covered with metal or other non-absorbent material and if desired divided by division ribs as *a* (shown by dotted lines in Fig. 2) into a series of races. At the upper end of the apparatus is a feed pipe B having perforations *b* along its lower side and having a rotary worm B^1 therein, or the feed device may be in the form of a feed hopper or bin provided with an adjustable delivery nozzle or nozzles, or other feed device. From said perforated pipe B the ore in a pulverized condition and saturated with water is fed in a regulated quantity supplied from a cistern as C onto the inclined surface or table A in a thin paste.

D is a pipe fed from any convenient source and provided with nozzles *d* for supplying a small stream of water sufficient to carry the ore down the inclined surface or table in a thin film such being aided by transverse brushes or distributers E. The lower part of such inclined surface or table A dips into or terminates in a shallow trough or well F, hereinafter termed a trough, which when the apparatus is in use is filled with water to the level of an overflow lip or ledge F^1 arranged at the side or part of trough in front of the inclined table or surface, and outside of said ledge is a gutter G leading away at a downward inclination from such trough to a suitable bin, the upper end of said gutter being slightly below the level of the ledge of trough F to provide an overflow therefrom, while said ledge or lip F^1 is made in the form of a sliding plate secured by thumb screws *f* to be adjustable in order that the height of water in the trough may be regulated to a small extent. In the said trough F under the lower end of the inclined table A the front part of an endless traveling belt or table H is arranged, which table is carried on rollers *h* in such a manner as to have two inclined planes, one leading from under the water at front of trough to over its back edge, and the other plane leading down therefrom to deliver the materials aided by a stream or spray of water from a pipe H^1 to the inclined table A of another apparatus of the same kind, the construction being repeated as often as may be necessary or desirable and erected so that the whole will work continuously when once started. In Fig. 1 the traveling belts H are connected by a crossed belt h^1 on pulleys h^2 or two of the roller spindles, and to one of which pulleys motion is imparted.

If continuous action is desired the beforementioned cisterns C should be arranged in pairs, as shown in Fig. 2, each provided with stirrers or agitators C^1 carried on a central vertical spindle C^2 to which rotary motion is imparted and also they are furnished with man hole or feed doors C^3 and pressure gages C^4.

C^5 are gas supply, and C^6 gas outlet pipes, C^7 water supply, and C^8 water outlet pipes from cisterns, and by the arrangement of gas pipes shown, the gas, after being utilized in the one cistern, may be fed to the other cistern.

The transverse brushes or distributers E work at one end in guides E^1, while their other ends are carried by the pivoted levers E^2, the outer arm of each being attached by a rod E^3 to an eccentric E^4 on one of the rotary shafts of apparatus.

In order to effect the separation required an ore, which, either with or without washing, sifting or preliminary chemical treatment, possesses particles capable of flotation which it is desired to separate, and which washing and chemical treatment may be done in the cisterns C, is fed from the said cisterns into the perforated pipe B and from thence onto the said inclined surface or table A in a thin pasty condition and is then carried down by a small stream of water from the said pipe D in a thin film, which is evenly distributed by the transverse brushes E, to the surface of the water in the said trough F in the manner and direction favorable to the flotation of such particles thereof as are capable of flotation, and which it is desired to separate, notwithstanding that many or all of such particles may be of greater specific gravity than the water or other liquid. Most of such particles are carried along the surface of the water in the trough F into the gutter G leading away therefrom and thence into a bin at the end thereof to be dealt with as may be desired. The residue or remainder of the particles sinks in the water in the said trough F to the said endless traveling belt H, which carries it upwards and over the back edge of trough and delivers it aided by a stream of water from pipe H^1 to another inclined table A at a lower level, and so on till the required separation is effected, when the ultimate remainder may be dealt with as may be desired.

The length and inclination of the surface or table, the quantity of water used to form the stream and the height of the said adjustable lip or ledge, should be regulated so as to bring about a speed and direction necessary to deliver a thin film of the ore onto the surface of the water in the trough and to carry a thin film of the particles capable of flotation which it is desired to separate along such surface and the dimensions and adjustment of the endless traveling belt or table and the

breadth of the trough should be sufficient to enable all or nearly all the particles not capable of flotation or which it is not desired to separate to sink, and be delivered to the next inclined surface or table. The ascertainment of these matters can be easily made by a few trials having regard to the ore under treatment and the liquid or liquids used and where desirable adjustments can be made in some of them without altering the others.

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

1. A process of separating zinc blende particles from ores, tailings, and concentrates in a pulverized condition comprising the freeing of zinc blende particles from the carbonates and other impurities by first submitting the material to the action of a chemical re-agent, and then discharging the material in a film-like manner into a body of water by delivering the material in a thin pasty condition in the presence of a stream of water upon an inclined surface extending to said body of water, and then separating the zinc blende floating on the water from the remaining ores, tailings, or concentrates which precipitate in the body of water.

2. A process of separating zinc blende particles from ores, tailings, and concentrates in a pulverized condition comprising the freeing of zinc blende particles from the carbonates and other impurities by first submitting the material to the action of a chemical re-agent, and then discharging the material in a film-like manner into a body of water by delivering the material in a thin pasty condition in the presence of a stream of water upon an inclined surface extending to said body of water, simultaneously with the travel of the material upon said inclined surface subjecting the material to a thinning out action, and then separating the zinc blende floating on the water from the remaining ores, tailings or concentrates which precipitate in the body of water.

In witness whereof I have hereunto set my hand in presence of two witnesses.

AUGUSTE JOSEPH FRANÇOIS DE BAVAY.

Witnesses:

C. HARTLETT,

BEDLINGTON BODYCOMB.