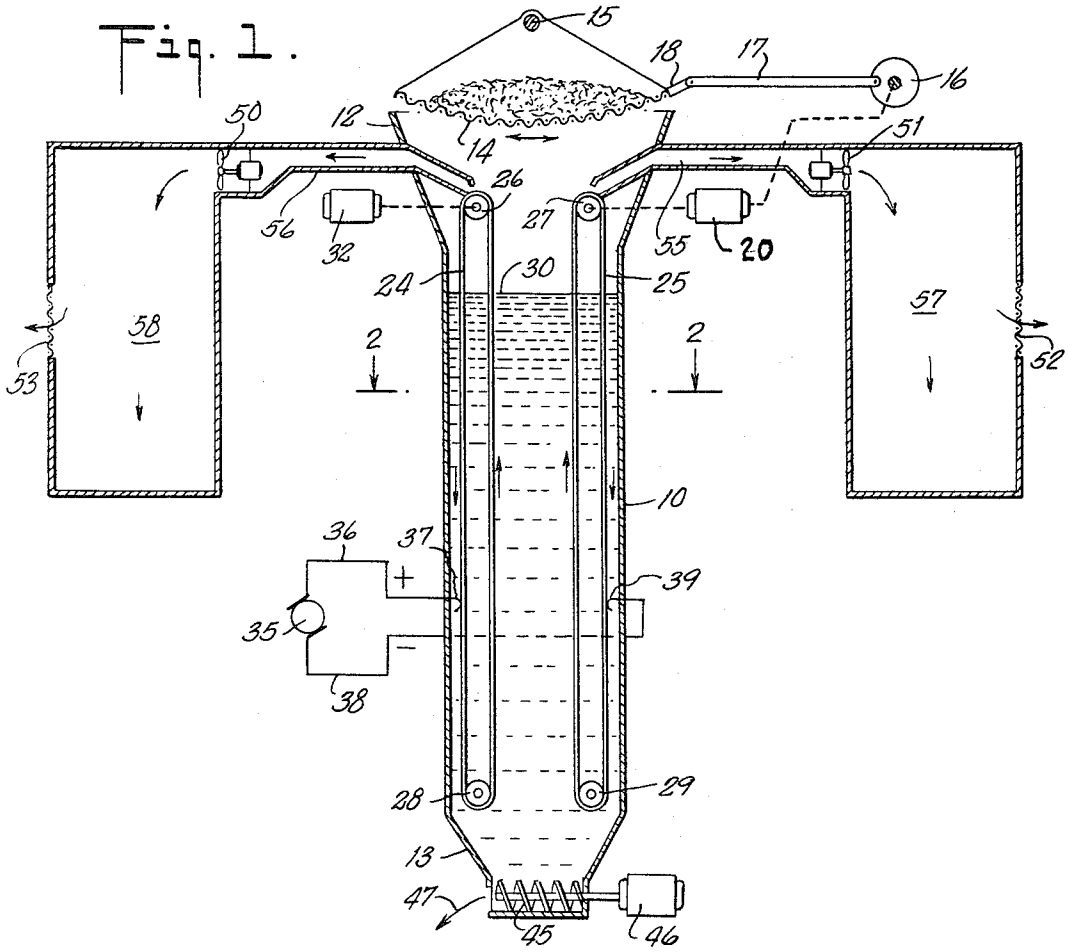
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IONIC SEPARATOR

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Fig. 1.



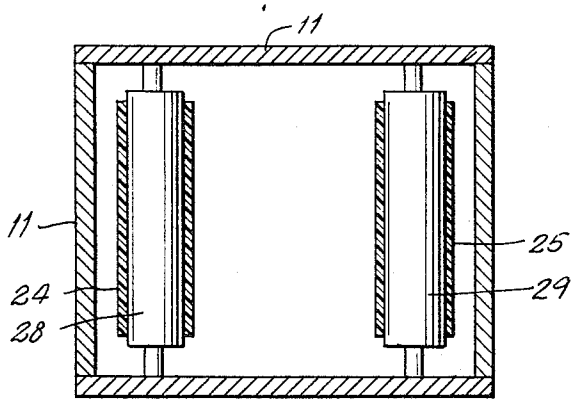


Fig. 2.

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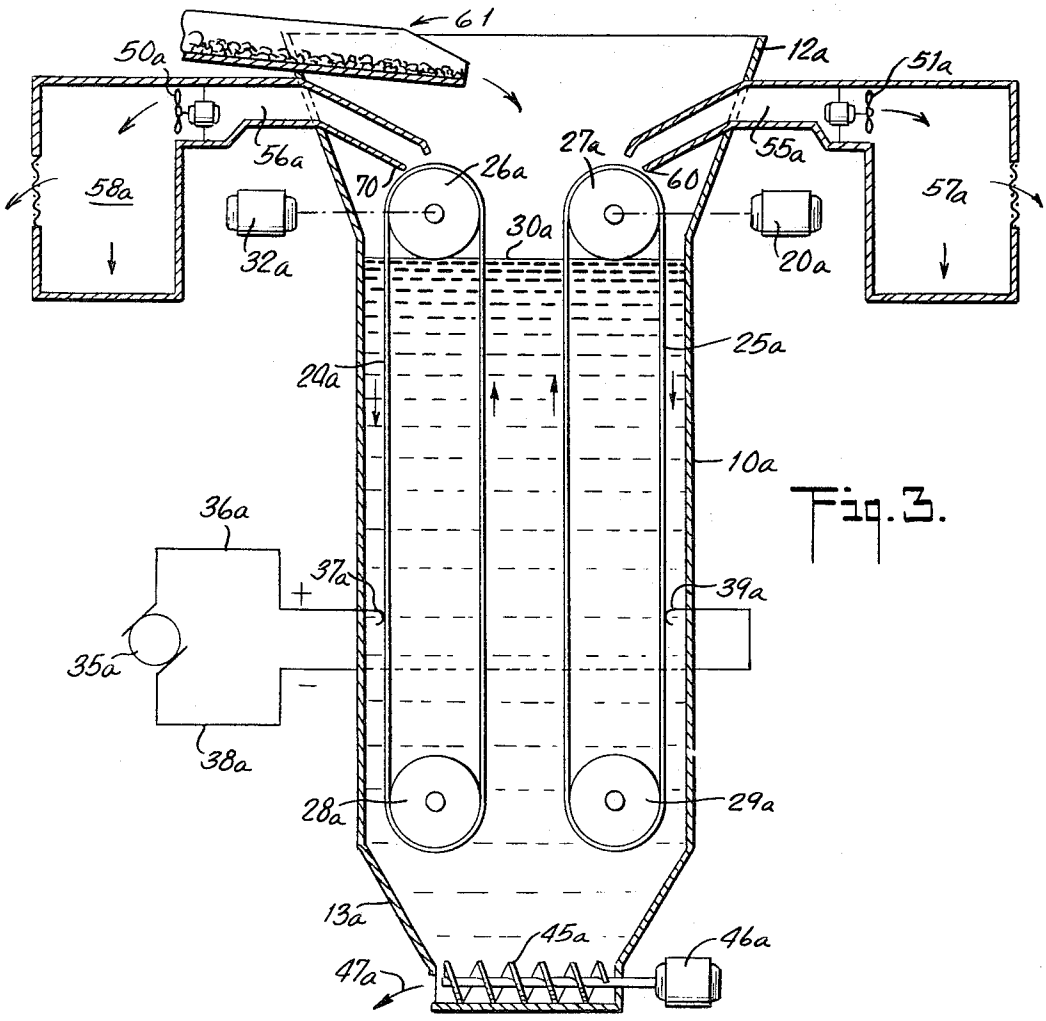


Fig. 3.

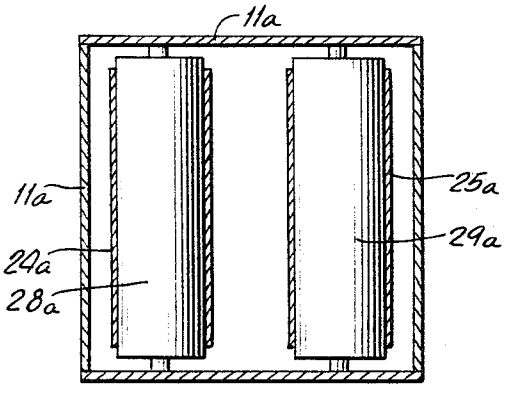


Fig. 4.

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3,396,097

Patented Aug. 6, 1968

3,396,097

IONIC SEPARATOR

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Filed June 19, 1964, Ser. No. 376,379

3 Claims. (Cl. 204—300)

ABSTRACT OF THE DISCLOSURE

A device is provided which is useful for the recovery of values from finely divided ore, the device comprising a vertical tank provided with a pair of spaced-apart, vertical, continuous, metallic belts adapted to move upwardly in parallel paths within the tank. A high D.C. voltage is applied between the belts which are immersed for the most part in water which is maintained at a high level within the tank. As the finely divided ore particles are added to the tank and fall downwardly therein, between the upwardly moving belts, constituents of the ore particles are ionized and attracted to the belts and are carried to the top of the tank where they are removed.

This invention pertains to an ionic separator. One object is to provide an improved device of this character which is economical of space, efficient in operation and in one modification is adapted for the separation of extremely fine ore particles which are not formed into a slurry but are sifted into and fall through a depth of water while subjected to a powerful electric field produced by high voltage direct current with a very small amperage. In another modification, when chinle shale is the starting material, the ore is first soaked in water, which causes the shale to break up into very fine particles, and then the wet particles are introduced directly into the top of the separator without passing through any sieve or like device which is used with dry particles. The wet particles thus settle down through the water therein and are subjected to the powerful electric field, and the desired separation is effected as hereinafter explained.

The invention will be more readily understood by consideration of the drawings and specification, to which reference may now be had.

FIG. 1 is a sectional elevation of one form of the ionic separator of this invention with certain of the elements shown diagrammatically.

FIG. 2 is a sectional plan view on the line 2—2 of FIG. 1.

FIG. 3 corresponds to FIG. 1 and is a modification of my invention especially adapted to process chinle shale or like material.

FIG. 4 is a sectional plan view on the line 4—4 of FIG. 3.

Referring to FIGS. 1 and 2, the device illustrated comprises an upright tank **10** which is preferably square or rectangular in section, as shown in FIG. 2, but may be cylindrical and which has a height not less than five times its diameter or width.

The tank **10** may be built of plastic boards or plants **11** but is sealed so as to be watertight. It is tall relative to its cross section and has an outwardly flaring upper end **12** and an inwardly tapering lower end **13**.

An oscillating sieve **14** is mounted to swing on a horizontal supporting shaft **15** in response to an eccentric **16** connected by a link **17** to the sieve arm **18**. The eccentric is driven by an electric motor **20**.

Within the tank are two continuous belt curtains **24** and **25** which are almost entirely immersed in water, the level being maintained high in the tank **10** as indicated at **30**.

The continuous belt curtains are substantially identical

and are mounted on sheaves **26** and **27** at the top and on sheaves **28** and **29** at the bottom. The arrangement is such that the adjacent belt curtains are spaced about eight inches apart. The belts may be flexible metallic belts or may be plastic belts which have metalized outer surfaces.

The motor **20** is connected to drive sheave **27** and a motor **32** is connected to drive sheave **26**. The sheave **27** is driven clockwise and sheave **26** counterclockwise, as seen in FIG. 1. Thus the adjacent belt curtains move slowly upward parallel to each other.

A direct current generator **35** applies about 50,000 volts D.C. through + line **36** and brush **37** to belt **24** and by — line **38** and brush **39** to belt **25**.

The effect of the high voltage application is to produce an ionic discharge between the entire length of the belts which are immersed in water, while a very minute current, as for example 200 milliamperes, flows from one belt to the other.

A transverse screw conveyor **45** is located at the bottom of the tank **10** and is driven by a motor **46** to discharge tailings as indicated at **47**. The tailings are damp and sufficient water is added to the tank **10** to maintain the desired water level as indicated at **30**.

Vacuum collectors **55** and **56** are arranged to scrape and suck the particles, separated by the ionic action between the belt curtains, from the belt **25** at sheave **27** and from the belt **24** at sheave **26**.

The vacuum collectors **55** and **56** discharge respectively into accumulating tanks **57** and **58**.

The operation of the separator is as follows:

Very finely divided ore, which contains very small percentages of gold, is supplied dry to sieve **14** and is sifted therethrough as the sieve is oscillated by eccentric **16** and falls downward through the depth of water in tank **10**. The ore is preferably of a fineness to pass through a 300 mesh screen.

As the ore slowly falls, it is subjected to the ionic action of the direct current field set up between belts **24** and **25**. Consequently, particles of gold in the form of ions which are negative are attracted to and adhere to belt **24**, while other gold particles in the form of positive ions are attracted to and adhere to belt **25**. The vacuum nozzles and scrapers remove the gold particles at sheaves **26** and **27** and they are deposited in accumulator tanks **58** and **57**.

The scrapers are primarily used to loosen the ore particles adhering to the belts **24** and **25** as they reach sheaves **26** and **27** so that the vacuum collector may transfer them to the tanks **58** and **57**, respectively. The vacuum may be formed by small fan motors **50** and **51**, screens **52** and **53** being set in the walls of tanks **57** and **58** to permit air to escape.

The fact that the belts are immersed in water to a depth which is great relative to the spacing between them, provides for an extensive electric field and adds to the effectiveness and capacity of the separator.

Referring to FIGS. 3 and 4, like parts and elements are designated by the same reference characters except that the suffix *a* is added.

The sieve and oscillator are unnecessary and are omitted in this modification, which is specifically adapted for processing chinle shale. This is a silicate much like ordinary clay except that it usually includes small quantities of precious metals such as gold and platinum, in addition to elements such as chlorine, bromine and the like.

While the quantities of gold and platinum may be small, hitherto many attempts have been made without success to recover these precious metals, because their value per ton of the original ore is sufficiently great to be economically attractive.

The chinle shale as mined is soaked in water with the result that the shale breaks up into minute particles. These

wet particles are introduced into the top of the separator, through trough **61**, and gradually pass downward through the body of water maintained at level **30***a* in the separator.

A powerful electric field is set up between stainless steel sheets and is produced as in the modification of FIGS. 1 and 2, by the application of a high voltage D.C. source of electricity **36***a* to the stainless steel sheets **24***a* and **25***a* at **37***a* and **39***a*. In this way a powerful electric field is set up between the sheets **24***a* and **25***a*, and the gold is separated by ionization. The ions are deposited on sheets **25***a* and **26***a* and are carried upward on the sheets, are then loosened by scrapers **60** and **70** and removed by vacuum through pipes **55***a* and **56***a* and delivered into tanks **57***a* and **58***a*. After the gold has been removed, the tailings which bulk much larger fall down and are carried out by conveyor screw **45***a*, driven by motor **46***a*, and discharged as indicated at **47***a*.

Modifications may be made without departing from the spirit of the invention, and only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. A concentrator comprising a vertical tank having a height not less than five times its diameter or width, a pair of spaced-apart, vertical, continuous, metallic belts located substantially within said tank and adapted to move upwardly in parallel paths, means for moving said belts, means for applying a high D.C. voltage between said belts, means for maintaining water at a desirable level within said tank, means for feeding finely divided ore into the top of said tank for downward movement between said belts and means provided at the top of said tank for collecting separated ore particles adhering to said belts.

2. The structure of claim **1** having a transverse screw conveyor at the bottom of the tank for the removal of tailings.

3. The structure of claim **1** in which said means for collecting the separated ore particles adhering to the belts comprises vacuum tubes connected to independent tanks and having suction nozzles located to recover the ore particles from the respective belts as they pass to the top of said tank.

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