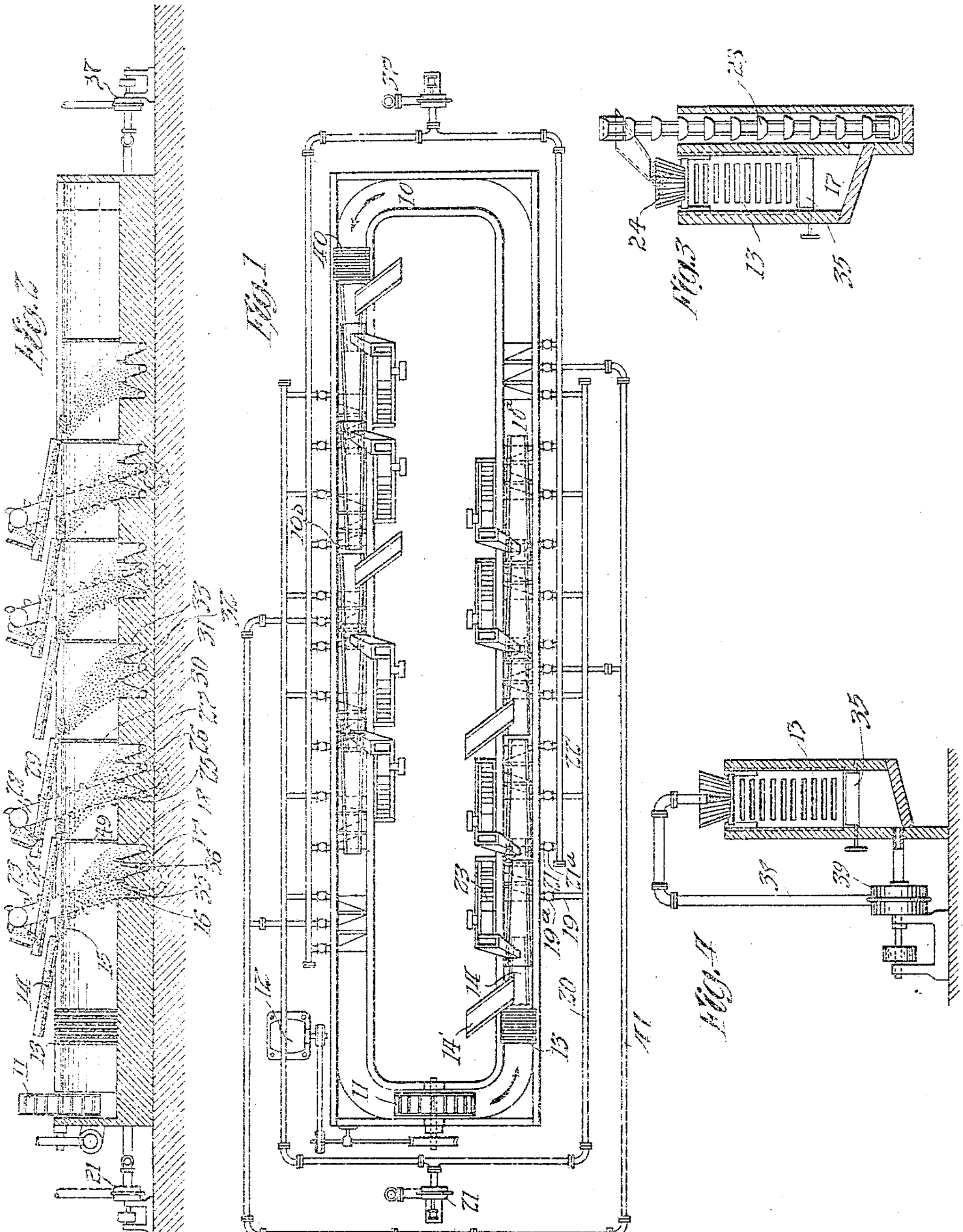
T. A. EDISON.
MEANS FOR CONCENTRATING ORES.
APPLICATION FILED MAY 23, 1912.

1,167,638.

Patented Jan. 11, 1916

3 SHEETS—SHEET 1.



Witnesses:
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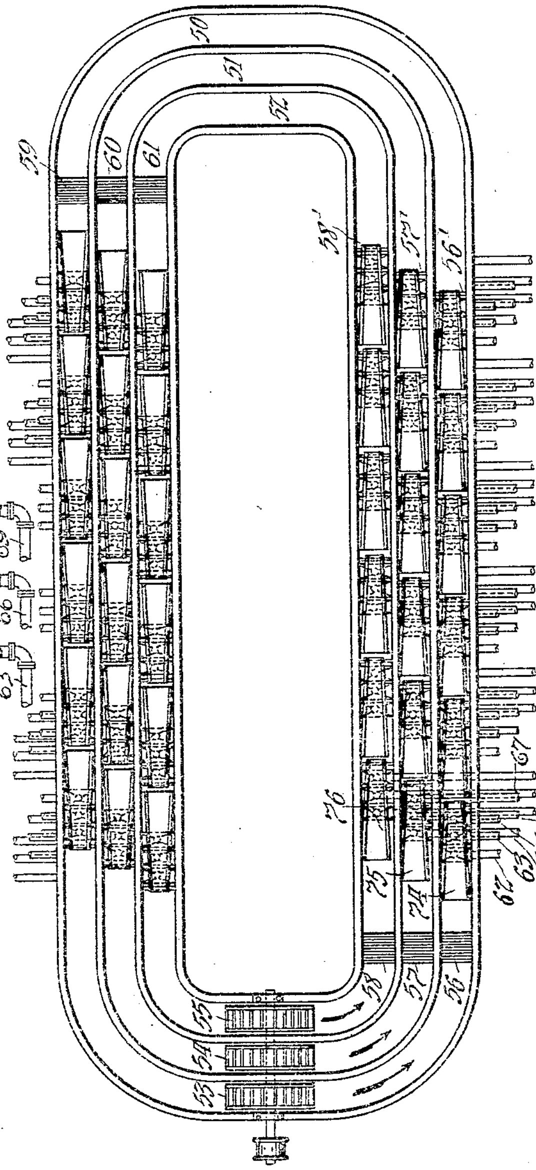
Henry Lanahan

Inventor:
Thomas A. Edison
by Frank L. Dyer
his Atty

Fig. 5



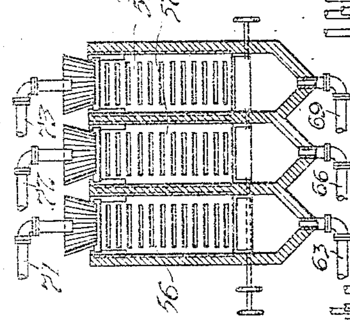


Fig. 6

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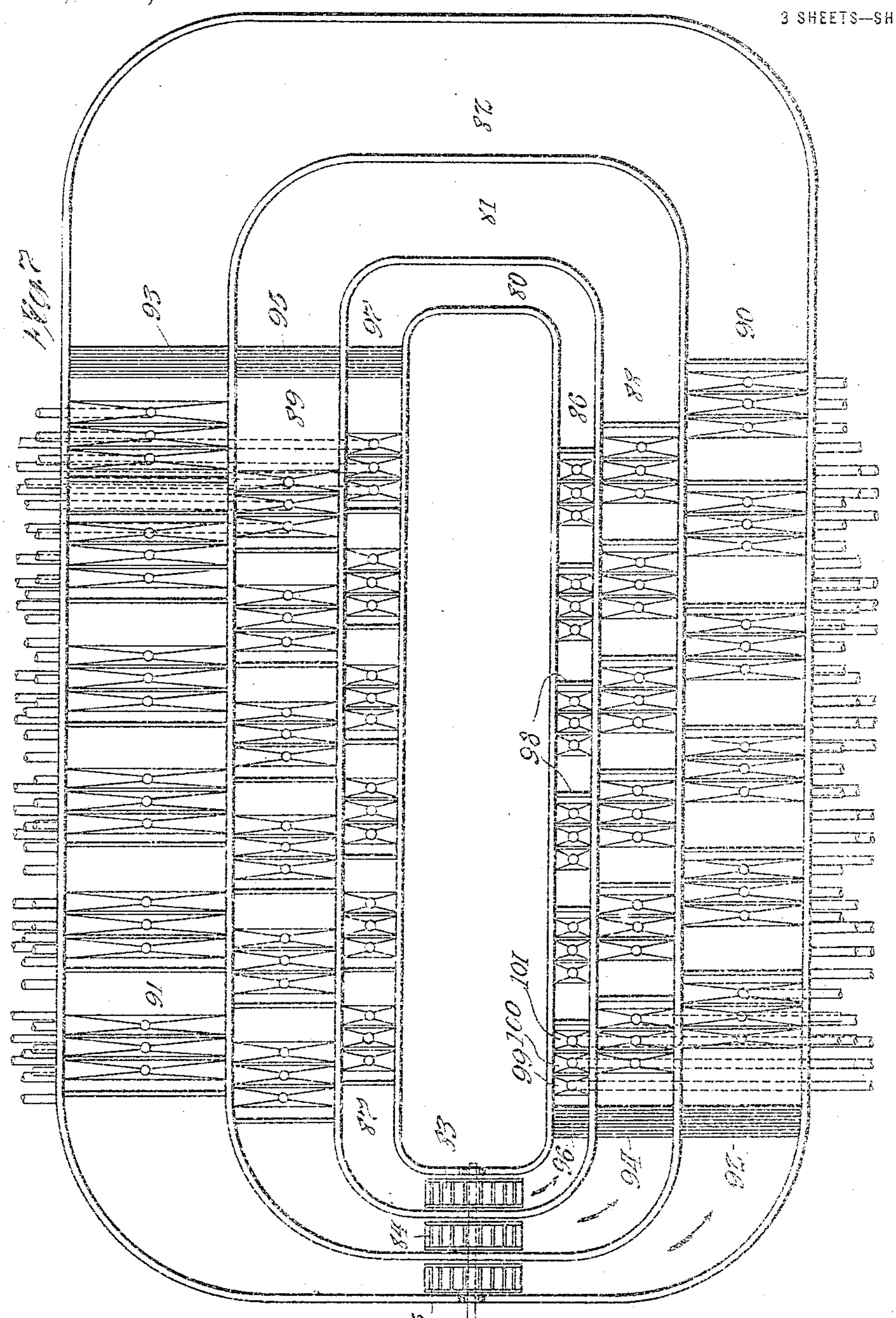
3 SHEETS—SHEET 3.



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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF LLEWELLYN PARK, WEST ORANGE, NEW JERSEY.

MEANS FOR CONCENTRATING ORES.

1,167,638. Specification of Letters Patent. Patented Jan. 11, 1916.

Application filed May 23, 1912. Serial No. 699,109.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, and a resident of Llewellyn Park, West Orange, Essex county, New Jersey, have invented a certain new and useful Means for Concentrating Ores, of which the following is a description.

My invention relates to improvements in means for concentrating ores, in which the ore constituents to be separated and separately collected are of different densities.

The carrying or transporting power of flowing water or other liquid depends upon the velocity of the liquid and the density and size of the particles subjected to the carrying or transporting influence of the flowing liquid. For any definite velocity of flow of the liquid, the distance through which a particle is carried depends upon the density and size of the particle and also upon the depth of the liquid; the less dense the particle is, the greater the distance it is transported, and vice versa, and the less the size of the particle, the greater the distance, and vice versa. The deeper the liquid is the greater distance the particle is transported and vice versa. Ore constituents of different compositions have as a rule different densities, and ore constituents of like composition have as a rule substantially the same density. I propose to use the differences in the carrying or transporting effect of a uniformly flowing liquid to separate ore constituents of different densities and unlike compositions, and to concentrate ore constituents of like densities and compositions. My improved method consists generally in subjecting uniformly sized ore to the separating influence of a slowly and uniformly moving flow of liquid, substantially free from eddies and whirls, and sufficiently deep to cause the separation and deposition of the ore constituents at different distances from the place of introduction of the ore in accordance with the densities of the constituents, collecting the different classes of ore constituents thus separated and preferably as concentrates, middlings and tailings, and removing the same. The concentrates are carried off for such further operations as are necessary or desirable, and the tailings are removed and disposed of. The middlings may be again subjected to the separating and concentrating influence of a uniformly flowing liquid of the character hereinbefore described, either prior to or subsequent to recrushing, and a more complete separation thus obtained. These steps may be repeated as many times as desired. Under some circumstances I may find it desirable to apply the process to the concentrates in order to obtain a higher degree of concentration.

My invention includes also means for carrying out my improved method, and both the method and means are more fully described hereinafter and claimed.

For such further description, reference is had to the drawings which accompany and form a part of this specification, and in which—

Figure 1 is a plan view of a concentrating tank and other apparatus constituting one embodiment of means suitable for carrying out my improved method; Fig. 2 is a vertical, longitudinal, sectional view of a portion of the apparatus shown in Fig. 1; Fig. 3 is an enlarged, transverse, sectional view of a portion of the apparatus shown in Figs. 1 and 2; Fig. 4 is a view similar to Fig. 3, but showing a pipe and pump for elevating the middlings instead of a bucket elevator; Fig. 5 is a plan view illustrating a plurality of concentrating tanks advantageously arranged; Fig. 6 is an enlarged, vertical, transverse, sectional view of a portion of the apparatus illustrated in Fig. 5; and Fig. 7 is a plan view illustrating a plurality of concentrating tanks of modified form arranged in a manner similar to that illustrated in Figs. 5 and 6.

Referring particularly to Figs. 1, 2 and 3, an elongated, substantially level, endless tank of substantially the same cross section throughout its length is shown at 10. This tank consists of a series of portions, preferably straight, in which separation and concentration of the ore takes place, connected by rounded portions or by rounded portions and other straight portions. In the apparatus illustrated, I have shown two such straight portions 10^a and 10^b for the concentration of the ore. The tank 10 contains a liquid, preferably water, of suitable depth, and means for producing a flow of the water through the tank is provided, such, for example, as a water wheel 11. The water wheel 11 may be driven by any suitable means, as for example, the electric motor 12 connected or geared thereto, and is driven at such a velocity as to produce the desired rate of flow of the water, which is preferably a rather slow rate. In Fig. 1, the direction of the flow of water is indicated by the arrows. The width of the tank, the depth of the water, and the rate of flow may be varied within wide limits, depending on the character and size of the cre to be treated. For example, I have employed a tank about fourteen inches wide, with a flow of water at about sixteen feet per minute and about three feet deep when working with material of 25 mesh. In my improved method it is desirable that the lines of flow of the water shall be substantially parallel to the general direction of flow of the water, that is to say, the flowing water shall be substantially free from whirls and eddies, and that the velocity along all of the lines of flow shall be substantially uniform throughout each cross section of those portions of the tank in which separation and concentration of the ores take place, and I provide means, such as baffle plates 13, which are slotted or perforated, and located across the tank in the path of the water after it leaves the water wheel 11 and at the entrance of the straight portion 10ª in order to produce this result, and to free the water from such waves, eddies, and whirls as are produced therein by the water wheel. The ore which is to be operated upon is crushed and sieved to a substantially uniform size by any suitable means, and preferably by a wet process, and is introduced into the uniformly flowing water at the surface thereof preferably in a thin sheet, or what is equivalent to a thin sheet, a series of thin streams. I have illustrated a feed chute 14 for introducing the thin sheet of sized ore particles into the water. The feed chute 14 may be provided with longitudinally extending grooves, as indicated in connection with feed chute 24 in Fig. 3, to insure the feeding of the material in a thin sheet, or any other suitable means to insure this result, such as a roller feed, may be employed. The sized ore may be introduced into the feed chute 14 by any suitable means, such as a feed chute 14′. A float 15 is provided adjacent the outlet end of the chute in order to insure complete submersion of the ore. Any suitable means is provided to prevent the float being carried away from its operative position by the water current. At a suitable distance from the outlet end of the feed chute 14, a group or series of pockets 16, 17 and 18 is provided, extending transversely across the bottom of the tank. On account of the varying transporting effect of the water, the least dense constituents of the ore are transported the greatest distance before being deposited, the densest constituents are transported the least distance, and the constituents of intermediate density are transported a distance intermediate between the two distances mentioned. The pockets 16, 17 and 18 are located so that the densest constituents or concentrates are deposited in the first pocket, that is, in 16, the least dense constituents or tailings are deposited in the pocket 18, and the middlings, or constituents of intermediate density or a mixture of the densest and least dense constituents, are deposited in the intermediate pocket 17. Adjustable parting boards 35 and 36 are provided between the pockets 16 and 17, and 17 and 18 respectively, enabling the operator to vary the effective receiving areas of the pockets and still further control the separation of ore constituents into concentrates, middlings and tailings. The concentrates deposited in the pocket 16 are removed from the pocket through pipe 19 communicating with a main pipe 20 to which is connected a pump 20ª. The concentrates are carried off by means of the pipe 20 and pump 20ª to any convenient point for such further processes or operations thereon as may be necessary or desirable. The tailings deposited in the pocket 18 are removed therefrom through pipe 21 communicating with a main pipe 22, which is connected to a pump 37. The tailings may be carried off through the pipe 22 to any convenient point and disposed of. The middlings deposited in the intermediate pocket 17 are elevated by any suitable means, such, for example, as a bucket elevator 23, and deposited in a feed chute 24, which is preferably longitudinally grooved from which they are fed into the flowing water to be again subjected to its separating influence.

One or more slotted or perforated baffle plates 49 are provided in the path of the flowing water after it has passed the first group of pockets 16, 17 and 18 in order to insure uniform velocity in all portions of its cross section during the next separating operation. The middlings received in the feed chute 24 from the elevating means 23 are introduced into the water, preferably in a thin sheet at a point beyond the baffle plate 49. A float similar to the float 15 is provided for insuring the complete submersion of the material fed from the feed chute 24. A second group or series of transverse pockets 25, 26 and 27 is provided in the bottom of the tank at suitable distances from the outlet of the feed chute 24 to receive the ore constituents deposited at various points in the flow of the water. In the first of these pockets 25, concentrates are deposited, in the second, 26, middlings are deposited, and in the third, 27, tailings are deposited. The concentrates are carried off by means of a pipe communicating with the main pipe 20 for the concentrates, and the tailings from the pocket 26 are carried off through a pipe communicating with the main pipe 22 for the tailings. The middlings from the intermediate pocket 26 are elevated by suitable means, such as a bucket elevator 28, and deposited in the feed chute 29, similar to the feed chute 24, from which they are fed into the flowing water to be again subjected to the separating process. One or more baffle plates 30 are provided beyond the group of pockets 25, 26 and 27 in order to insure uniform velocity of the water where the material from the chute 29 is introduced. The material from chute 29 is introduced beyond the baffle plate 30, preferably in a thin sheet, and underneath a float similar to float 15 for insuring the complete submersion of the material. A third group of pockets 31, 32 and 33 is provided at suitable distances from the outlet end of the feed chute 29 for receiving the different ore constituents of the ore fed from the feed chute 29 when deposited. In this group of pockets the concentrates are received in the pocket 31, the middlings in the pocket 32, and the tailings in the pocket 33. The concentrates from the pocket 31 are carried into the main pipe 20 by means of a suitable pipe connection; the tailings from the pocket 33 are carried into the pipe 22 for the reception of the tailings; and the middlings are carried into a pipe 41 by which they may be conveyed to any convenient point to be reground and again submitted to the separating and concentrating process. Adjustable parting boards similar to parting boards 35 and 36 are provided between adjacent pockets of each group.

I have now described one complete series of steps in my improved method, but obviously my method is not limited to the subjection of the material to the action of the flowing water the exact number of times described. As many groups of pockets as desired may be provided, and in some cases only a single group may be necessary, and the crushed and sized material subjected to the process one or as many times as may be desired. Additional sets of separating apparatus may be provided in the tank, and I have shown one additional set similar to the set described in the portion of the tank immediately succeeding the portion just described, and have shown two such sets in the other straight portion 10^b of the tank. I may also provide a set of baffle plates 40 through which the water must pass in order to reach the second straight portion 10^b of the tank.

It should be observed that in my improved process I have subjected substantially uniformly sized particles of ore to the influence of the carrying or transporting effect of a slow and substantially uniform flow of liquid, the velocity being insufficient to retain the ore constituents in suspension, and the depth being sufficient to insure the desired degree of separation of the ore constituents of different densities, whereby the constituents of different densities are deposited at different distances from the point where the material is introduced into the liquid. In this way I am enabled to separate and collect the different grades of material.

Instead of using bucket elevators for feeding the middlings to the next following feed chute, I may use a pipe and actuate the middlings by a suitable pump. This modification is shown in Fig. 4, in which 38 indicates a pipe leading from a pocket intended to receive middlings and depositing the same in the next succeeding feed chute, the middlings and water being actuated by means of a pump 39. Suitable valves 19^a, 21^a, etc., are provided in pipes 19, 21, etc., for controlling the flow of the ore constituents mixed with water from the various pockets.

In Figs. 5 and 6 I have shown a series of tanks lying one within the other, each of the said tanks being constructed and arranged in the manner hereinbefore described in connection with Figs. 1, 2, 3 and 4. Three tanks 50, 51 and 52 are shown, the tank 52 being the inner one, the tank 51 surrounding the tank 52, and the tank 50 surrounding the tank 51. Water wheels 53, 54 and 55, or other suitable means for producing a flow of water, are provided for the tanks 50, 51 and 52 respectively. The water wheels 53, 54 and 55 may be driven independently of each other or in unison. Groups of baffle plates 56, 57 and 58 are provided near the entrance of the first straight portions of the tanks 50, 51 and 52 respectively, and groups of baffle plates 59, 60 and 61 are provided near the entrance of the second straight portions of the tanks 50, 51 and 52 respectively. Additional baffle plates are located in the tanks at points beyond each group of pockets in the manner shown in Fig. 2. Such baffle plates are indicated at 56′, 57′ and 58′ in tanks 50, 51 and 52 respectively. At 74, 75 and 76 are shown the first feed chutes of the series of feed chutes provided for tanks 50, 51 and 52 respectively. Each of these tanks is provided with pockets in the manner hereinbefore described in connection with Figs. 1, 2, 3 and 4. Referring to the first group of pockets of each of the tanks, pipes 62, 63 and 64 lead from the pockets for receiving the concentrates, middlings, and tailings respectively in tank 50; 65, 66 and 67 denote pipes leading from the pockets receiving the concentrates, middlings and tailings respectively in tank 51; and 68, 69 and 70 represent pipes leading from the pockets which receive the concentrates, middlings and tailings respectively in tank 52. Similarly situated pipes are provided for each of the groups of pockets in all of the tanks. The pipes for receiving the concentrates from any one tank or from all of the tanks may lead to a common pipe, and the pipes conveying the tailings may lead to a common pipe. Each of the pipes leading from a pocket which receives middlings may lead to the next succeeding feed chute through pipes, as indicated at 71, 72 and 73, when it is desired to again subject the middlings to the process, or the middlings may be conveyed to a convenient point for recrushing. Among the advantages of the structure illustrated in Figs. 5 and 6 are compactness and economy of construction. Tanks arranged in this manner occupy less space, and common walls may be employed.

In the modification disclosed in Fig. 7 I have illustrated three tanks, an interior tank 80, an intermediate tank 81, and an exterior tank 82. The interior tank 80 has a narrow straight portion 86 and a wider straight portion 87. Tank 81 has a straight portion 88 wider than the straight portion 87 and a wider straight portion 89. Tank 82 has a straight portion 90 wider than the straight portion 89 and a straight portion 91 wider than the straight portion 90. Means for producing a flow of the water, such as water wheels 83, 84 and 85, are provided for the tanks 80, 81 and 82 respectively. Sets of baffle plates 92 and 93, 94 and 95, and 96 and 97 are provided for the tanks 82, 81 and 80 respectively. The groups of pockets are provided in each of the tanks as in the structures hereinbefore described, and baffle plates 98 are provided in each of the tanks beyond each group of pockets. In the tank 80, the first group of pockets consists of a pocket 99 for concentrates, a pocket 100 for middlings, and a pocket 101 for tailings. Similar groups are provided in this tank and in the other tanks. Pipes for conveying away the concentrates and tailings are provided, as described in connection with Figs. 5 and 6, and pipes for receiving the middlings and conveying the same either to be recrushed or to be again subjected to the process in the manner hereinbefore described are provided. Feed chutes and means for elevating the middlings are provided, but are not shown in this figure for the sake of clearness. In the modified form of tanks and arrangement of the same illustrated in Fig. 7, I have provided means for readily obtaining successively slower rates of flow of water. This result is due to the successively increasing areas of cross section of the tank portions 86, 87, 88, 89, 90 and 91 respectively. This construction is particularly adapted for separating and concentrating ore constituents of successively smaller sizes. I may start with sized ore of suitable mesh, subject it to the separating and concentrating influence of the flowing water in tank portion 86, recrush the middlings and subject them to the separating and concentrating influence of the more slowly flowing water in tank portion 87, and so on until the separation and concentration has been carried to any desired extent.

Having now described my invention, what I claim as new therein and desire to protect by Letters Patent is as follows:—

1. Means for concentrating ores including a plurality of horizontally elongated, substantially level, endless tanks, said tanks being arranged adjacent to each other and so that each tank except one surrounds an adjacent tank, means for producing a uniform flow of liquid in a horizontal direction in portions of each of the tanks, means for introducing ore into the uniformly flowing liquid in each tank, whereby the ore constituents are separated and deposited according to their densities by the action of gravity and the flowing liquid, and means for collecting and removing ore constituents so deposited, substantially as described.

2. Means for concentrating ores including a plurality of horizontally elongated substantially level, endless tanks, said tanks being arranged adjacent to each other and so that each tank except one surrounds an adjacent tank, and means for maintaining a substantially uniform flow of liquid in a horizontal direction in portions of each of said tanks, substantially as described.

3. Means for concentrating ores including a plurality of horizontally elongated, substantially level, endless tanks, said tanks having concentrating portions of different widths and being arranged adjacent to each other and so that each tank except one surrounds an adjacent tank, each of said tanks having portions of different widths, and means for maintaining substantially uniform flows of liquid in a horizontal direction and at successively slower rates in concentrating portions of each of said tanks, substantially as described.

4. In apparatus of the class described, an elongated concentrating tank, means for maintaining a uniform flow of liquid therein, a feed chute wholly disposed above the flow of liquid for feeding ore into the liquid, and a float supported solely by the flow of liquid adjacent to and slightly beyond the outlet of the feed chute to insure the complete submersion of the ore fed from the feed chute, substantially as described.

5. In apparatus of the class described, an elongated concentrating tank, means for maintaining a uniform flow of liquid therein, means wholly disposed above the flow of liquid for feeding ore into the liquid, and a float supported solely by the flow of liquid adjacent and slightly beyond the outlet of the feeding means to insure the complete submersion of the ore fed from the feeding means, substantially as described.

This specification signed and witnessed this 21st day of May, 1912.

THOS. A. EDISON.

Witnesses:

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