This invention relates to new and useful improvements in methods of and means for sorting ore having a radioactive component.

In upgrading ore containing a radioactive component such as uranium, it is desirable to effect a preliminary separation so that the ore which is subsequently directed to concentration has as high a value as possible and various methods, such as that disclosed in the United States patent to La Pointe No. 2,617,526 have been proposed. All of these prior methods have merely involved the measurement of the radioactivity of the ore particle but in order to gain any information of value it is necessary that the ore particles be initially separated as to size for otherwise the radioactivity measurement is meaningless. Obviously the initial separation or sizing of the particles involves screening or separating equipment as well as additional time and labor.

Moreover, the desired component of these ores, such as uranium compounds, frequently occurs in widely varying concentrations throughout the ore body. For example, one inch cube of ore in place may assay 0.1% U3O8 whereas another cube a few feet away may assay 1% or even higher. Thus, there is said to be a range of mineral value throughout the ore body. In commercial mining operations, and particularly in hard rock mining, the ore is removed in chunks or particles having a broad size range. Frequently such range encompasses particles of much less than one inch in size to others of even one or two feet in size. While the very large sizes can be crushed to an average of 3 to 6 inch sizes without materially destroying the range of values, it is apparent that any commercial crushing operation which produces a product of fine particle size, say one-half inch and smaller, would destroy the range of values. Thus, the ore chunks which are very rich in uranium or other product will be ground together with the barren or low grade ore to produce a composite product, any portion of which will have substantially the same valuable component content as any other portion. Obviously, such a mixture is not markedly susceptible of upgrading by a practical mechanical separation. Thus, the inherent limitations in present-day commercial crushing practices impose a serious limitation upon mechanical upgrading of ore which has been crushed to a fine and substantially uniform size.

It is one object of this invention to provide an improved method for sorting ore having a radioactive component wherein the ore particle is simultaneously measured for both radioactivity and size, whereby any preliminary separation or sizing to obtain uniformity is unnecessary and a more economical and faster sorting operation may be carried out.

An important object is to provide an improved ore sorting method in which the ore particle is subjected to a device sensitive to radioactivity and at the same time is measured as to its size or mass, whereby the ratio of the radioactivity to the mass of the particle is determined to indicate the assay value of said particle.

Still another object is to provide a method, of the character described, wherein accurate measurement of the ratio of the radioactivity to the mass of the ore particle is effected and such measurement is thereafter utilized to direct the particle into the proper channel for acceptance or rejection.

A further object is to provide an improved apparatus having gamma ray scintillometers between which the ore particle is conducted for measurement of the radioactivity of the particle, together with means for determining the mass of said particle, whereby the ratio of radioactivity to mass may be indicated.

Another object is to provide improved means for utilizing the measurement of the radioactivity and the measurement of the mass or size of the ore particle to actuate an indicator or a sorting mechanism, whereby the individual ore particles are "accepted" or "rejected" in accordance with the ratio of radioactivity to mass or size.

A particular object is to measure the mass or size of the particle by utilizing the weight of the particle to actuate an electrical means so that the electrical values are representative of said size or mass; said electrical values being combined electrically with the radioactivity measurement of the particle to produce information concerning the ratio of the mass to the radioactivity of said particle.

Still another object is to provide an improved method and apparatus of the character described which accomplishes a substantially continuous measurement of the ore particles and wherein various means may be employed for measuring the mass or size of the ore particle; said apparatus also including an improved electrical measuring circuit for indicating the radioactivity to mass ratio and for operating any suitable sorting device.

Another object is to provide an improved method and apparatus for sorting ore in which the ore is sorted in discrete sections, the weight of the sections being permissibly variable over a broad range, and, if desired, each comprising single particles of ore or a plurality of particles which vary substantially in mass one from the other.

Other objects, advantages and features of this invention will be apparent to one skilled in the art upon the consideration of the specification, drawings and claims.

The construction designed to carry out the invention will be hereinafter described, together with other features thereof.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings forming a part thereof, wherein an example of the invention is shown and wherein:

FIG. 1 is a schematic, isometric view of an ore sorting apparatus, constructed in accordance with the invention, for carrying out the improved method;

FIG. 2 is a longitudinal sectional view, taken on the line 2--2 of FIG. 1;

FIG. 3 is a transverse, sectional view taken on the line 3--3 of FIG. 2;

FIG. 4 is a schematic diagram of the radioactivity measuring units;

FIG. 5 is a partial isometric view of one means of measuring the size or mass of the ore particle;

FIG. 6 is a block diagram of the electrical circuit;

FIG. 7 is a wiring diagram;

FIG. 8 is a partial sectional view of a modified form of the invention;

FIG. 9 is an isometric view of another manner of measuring the mass or size of the ore particle;

FIG. 10 is a schematic, isometric view illustrating another manner of measuring the mass or size of the ore particle;

FIG. 11 is a diagrammatic view of still another form of the invention;

FIG. 12 is an alternative embodiment of the invention;
FIG. 13 is an enlarged view showing some of the details, somewhat schematically, of the bucket conveyor, the weighing transducer and the triggering switch; and FIG. 14 is a schematic diagram of the electrical components used in the apparatus of FIG. 12.

Like characters of reference are used throughout the several views to designate like parts.

In the drawings the numeral 10 designates a conveyor which may be an endless belt mounted upon suitable rotating supports 11 which may be displaced laterally at a predetermined speed. Ore particles A having a radioactive component are adapted to be disposed upon the conveyor through an inlet hopper or conductor 12. Any suitable means (not shown) may be provided for controlling the deposit of the particles upon the conveyor. It being desirable that said particles are disposed in spaced relationship upon the conveyor.

As the conveyor 10 operates, the particles are moved along a longitudinal path and are caused to pass through a scanning head unit 13. As will be explained, the scanning head unit measures the radioactivity of each ore particle and also determines the mass of said particle, with the latter determination being made substantially at the same time that the radioactivity measurement is effected. The measurement of radioactivity and the determination of the mass of each particle provides information as to the radioactivity to mass ratio of the particle, and this information is utilized to direct the ore particle through either a discharge conductor 14 or a discharge conductor 14a. As shown in FIG. 1, the conductors 14 and 14a are disposed adjacent the discharge end of the conveyor and a deflect plate 15, which is located between the conductors, normally guides a particle from the conveyor into the discharge 14. The discharge 14 may be termed a rejected particle discharge, since all particles having a less than a predetermined or desired radioactivity to mass ratio value will be deposited into the conductor 14. The conductor 14a may be termed an accepted particle discharge and is adapted to receive all of those particles wherein the value of the radioactivity to mass ratio is above a predetermined point. For deflecting the particles which are to be accepted in accordance with the measurements made, a hinged deflector or gate 16 is pivotally mounted on the scanning head unit 13 and is adapted to be swung inwardly across the conveyor as indicated in dotted lines in FIG. 3. It is obvious that when the deflector is swung to its inward position overlying the conveyor the ore particle being carried along the conveyor is deflected or guided into the discharge conductor or chute 14a.

The deflector 16 is actuated by means of an electric solenoid 17 with the rod or core 18 of said solenoid being suitably connected with said deflector. As will be explained in detail, when an ore particle has a radioactivity to mass ratio above a predetermined value so that it is acceptable for subsequent concentration, the solenoid is energized whereby the deflector is swung to the dotted line position shown in FIGURE 3; in such position the ore particle is directed into the discharge conductor 14a. For returning the deflector to its original position, the discharge conductor 14a is formed with aligned openings 19 and adjacent one of these openings is a light source 20 which projects a light beam through the openings and on to a photoelectric cell 21. As the accepted ore particle falls downwardly through the conductor or chute 14a, said particle interrupts the light beam which is projected on to the photoelectric cell 21 and through a suitable electrical circuit this interruption of the beam is utilized to de-energize the solenoid 17 and thereby return the deflector 16 to its initial or starting position as shown in FIG. 1.

By obtaining the radioactivity of each ore particle and also determining at substantially the same time the mass, of said particle, it is possible to obtain the measurement of radioactivity to mass ratio of each particle. By ob-
of the deflector 16 to accept or reject an ore particle is of course actuated by the electrical circuit.

The electrical circuit functions to electrically mix the radioactivity with the measurement obtained by the elements sensitive to radioactivity with the measurement made by photoelectric cell 23 so that a ratio of the radioactivity to the mass may be obtained. If this ratio is above a predetermined value, solenoid 17 is energized to actuate the deflector 16; otherwise the solenoid remains inactive. If the radioactivity to mass ratio value is above the selected point, solenoid 17 is actuated to direct the ore particle into the accepted discharge conductor but as the particle falls through said conductor the light beam is passing to photoelectric cell 21 is interrupted whereby solenoid 17 is again actuated to return the deflector 16 to its starting or original position.

The wiring diagram of the electrical circuit is illustrated in FIG. 7, and referring to such figure, the input of the circuit is at the point indicated as "A." When the elements A1 to A4 are actuated by gamma ray emission from radioactive ore particles, a series of negative pulses are generated by the photo-multiplier tubes A11, A13, A13 and A14, which form a part of the elements A1 to A4. These negative pulses are fed to the input grid of a univibrator circuit which includes tubes T1 and T2. The univibrator has the positive output pulses of constant magnitude and duration through cathode follower T3 to the integrating circuit which comprises diodes T4 and T5, condenser C1 and resistance R1. A positive voltage is developed across C1 and R1 and this voltage is proportional to the radioactivity of the ore sample. This positive potential is then directed to the control grid G1 of a mixer tube M.

FIG. 7 is thus a preferred type of electrical circuit shown in block outline in FIG. 6. In FIG. 7 the univibrator circuit corresponds to the gamma ray pulse amplifier 39 of FIG. 6, the cathode follower and diode circuit of FIG. 7 corresponds to the integrating circuit 31, and the mixer tube M shown in detail in FIG. 7 is a preferred form of electronic mixer 32 indicated in FIG. 6, while the thyatron firing circuit 33 of FIG. 6 is illustrated in preferred form and greater detail in FIG. 7 as the circuit including thyatron 46, thyatron 144, and relay 41. The amplifiers including thyatrons 46, thyatron 144, and relay 41 corresponding to the particular ore particles included are shown in detail in FIG. 23 and 21, respectively, correspond to the photo tube circuits 34 and 35 of FIG. 6.

The purpose of the univibrator circuit is to convert the signals received from the scintillometer into a current having a potential which vibrates uniformly at a amplitude and frequency to the output from the scintillometer. The cathode follower and circuit including the tube diodes T4 and T5 convert the amplified vibrating potential to a rectified potential proportional to the output of the scintillometer which is constantly impressed upon the control grid G1 of mixer tube M so that the flow of current through tube M is controlled both by the output of photo tube 23 and from the scintillometer. Voltage from the cathode of mixer tube M is impressed on the control grid of thyatron 40 and prevents the thyatron from firing, closing relay points 41 and 42, until the voltage on the control grid of the thyatron tube falls below a predetermined value. Closing relay points 41 and 42 actuates the solenoid to operate gate 16.

When a particle of ore dropping through the chute cuts off light impinging upon photo tube 21, the voltage on the control grid 64 is of thyatron 140 is decreased. Decrease of voltage on the control grid 64 causes thyatron 140 to fire reversing the position of relay points 41 and 42 and returning the solenoid to its normal position.

The mass determination is made in accordance with the amount of light reaching the photoelectric cell 23, and obviously the greater the weight of the ore particle the less light which is received by said cell. This results in a positive voltage appearing across the cathode resistor R3, which voltage is inverted and amplified to the mass of the particle. The positive potential from the cathode resistor R2 is directed to the control grid G2 of the mixer tube M. It is thus evident that the potentials which appear at the control grids G1 and G2 of the mixer tube M are the positive potentials from the integrating circuit C1—R1, which is proportional to the radioactivity of the ore particle and the positive potential from resistor R2 which is inversely proportional to the mass of the particle. Thus the output positive voltage from the mixer tube M appearing across resistor R3 and impressed upon the control grid G3 of the thyatron tube 40 is proportional to the radioactivity to mass ratio of the ore particle under measurement.

If this positive potential which is impressed upon the control grid G3 of the thyatron tube 40 is of the predetermined or required magnitude as determined by a sensitivity control S and ratio controls R1 and R2, the gas thyatron tube 40 is fired, causing switch contacts of a relay 41 to close. This results in energizing the solenoid 17 which is connected with the deflector 16 and thereby swings the deflector across the conveyor 10 to direct the ore particle into the chute or conductor 14a. Of course, if the positive potential which has been impressed upon the control grid G3 of the thyatron tube 40 is below a predetermined magnitude, relay 41 is not actuated and solenoid 17 remains inactive, thereby permitting the ore particle to be discharged into the low grade or rejected discharge conductor.

Assuming the solenoid 17 is actuated to swing the deflector and guide the ore particle into the high grade discharge conductor 14a, said ore particle will interrupt the light beam between the light source 20 and the photoelectric cell 21. When this occurs, the photoelectric cell causes a positive pulse to be impressed upon the control grid G4 of a second gas thyatron tube T4. This thyatron T4 then fires to open the switch contacts of a relay 42, which functions to interrupt the plate supply voltage to the thyatron 40, thus quenching the latter thyatron and causing the switch contacts of relay 41 to return to a position which results in solenoid 17 returning the deflector to its original or starting position.

Although the foregoing electrical circuit has been found satisfactory for the purpose, it is obvious that other circuits could be employed. So long as the radioactivity of the ore particle is measured and the mass of said particle determined so that a radioactivity to mass ratio may be obtained, the purpose of the invention will be accomplished. The invention describes the radioactivity to mass ratio value as being utilized to actuate the deflector; however, it is evident that the thyatron tube 40 could actuate a signal device, such as glow lamp GL, so that a manual operation of the deflector could be carried out in accordance with such signal. It is thus evident that the invention is not to be limited to the specific or particular form shown or the particular electrical circuits disclosed.

It is obvious that a meter MT, such as a volt-meter, can be inserted in the circuit as shown in FIG. 7 to provide a continuous indication of the magnitude of the radioactivity to mass ratio.

In FIG. 8 a modified form of the invention is illustrated wherein discharge conductors 114 and 114a are substituted for the discharge chutes 14 and 14a of the first form. In this modification the deflector 16 is omitted and in lieu thereof a trap door 116 is provided to form a part of an inclined chute 117. The trap door is actuated by the solenoid 17. By observing FIG. 8 it will be seen that if the radioactivity to mass ratio is at a predetermined value, solenoid 17 will be operated to swing the trap door 116 to the position shown in dotted lines so that the ore particle will drop into the high grade ore conductor 114a. Upon passing through said conduc-
Referring now to FIGS. 12, 13, and 14, there is illustrated a form of the invention in which a bucket type conveyor is used as well as other modifications of the above described apparatus. This particular modification is particularly adapted to process discrete sections of the ore with each section varying substantially from the other in weight. The sections may also vary as to the number and size of ore particles each contains, and the manner in which the high grade ore is directed into the proper discharge.

In FIG. 10 a light source 52 is illustrated on one side of the conveyor 10 with a photoelectric cell 53 on the opposite side adapted to receive a light beam. As the ore particle passes between light source 52 and cell 53 the light beam is interrupted by an amount equal to the size of the particle. The size of the particle is approximately proportional to its mass, and the photoelectric cell 53 which receives more or less light dependent upon the size of the particle, can be utilized to provide an approximate determination of the mass of the particle.

The weight readings of the ore 215 which is measured upon the strain gauge when the bucket is centered on the platen. The gauge can be adjusted so that its output reflects only the net weight of ore in the bucket.

As shown, the strain gauge is situated several buckets away from the detector 13. It could be placed immediately under the detector so that both would be powered from the same bucket but the illustration shows that this is not necessary. The gauge can be placed at any filled bucket on the belt and by feeding its output through wire 206 to a memory or time delay circuit, the feeding of the weight signal to the electronic mixer 32 can be delayed for any desired time so that the radio-activity and mass readings arrive at the same time to the mixer. Thus, a magnetic wire recorder 207 can be provided with an input recording head 208 into which the weight signal is fed by wire 206. The wire recorder 207 will be of size and will be driven in synchronism with conveyor 11c as by linkage 209. Thus the recorder will turn at a speed such that the portion of the wire on which the weight intelligence for one bucket has been recorded will reach playback head 210 at the same time that bucket is proximate to detector 13 for taking of the radioactivity measurement. In this manner, the radioactivity measurement and the mass determination can be fed into electronic mixer 32 at the proper time.

To assure this proper feeding into the mixer in a more precise manner, a trigger means can be provided to render the mixing circuit effective only when the radioactivity and mass intelligence are being fed simultaneously into it. Such trigger means can take many forms but is shown as including a switch 211 which has its contacts closed by wiper arms 212 carried by the buckets so as to render the trigger circuit 212 operative at the time the bucket in question is directly under detector 13. Thus, when the radioactivity to mass ratio is of sufficient value, solenoid 17 operates to swing the deflector vane and cause the particle to discharge into the high grade chute 62. On the other hand, if the radioactivity to mass ratio is below a predetermined value, the deflector vane remains inactive and the particle falls into the low grade chute 61. In all forms of the invention both the radioactivity and the mass of the ore particle are measured so that an accurate determination of the true assay value of the particle may be had.
by playback head 215 and applied to the input of thyatron firing circuit 33a. If the ratio exceeds a predetermined value, the circuit will cause solenoid 17 to move gate 16 so that the particular bucket will reach the playback head 215 at the time the bucket reaches the end of the conveyor and is ready to dump into the discharge chute. This permits the detector to be situated a substantial distance from the end of the conveyor which is of advantage for mechanical constructional reasons. Should the detector be located at the end of the conveyor, the wire recorder or memory unit can be eliminated and suitable time delay built, if necessary, into the electronics system to assure that the signal sent to the thyatron firing circuit would be at a time when the bucket was just beginning to dump.

Much of the circuitry of FIG. 14 is common to that described for FIG. 7. Accordingly, further description of the common portion will not be given. It will be seen that the output signal from weight cell 204, which for this circuit is a positive potential inversely proportional to the mass of the ore, is again fed to grid 203 of the mixer tube M.

The trigger circuit is shown as including a thyatron 216 which normally is biased to cut-off condition by connection 217 of its grid with a negative source of potential. However, upon closing of switch 211 by one of the buckets, the grid is connected to a positive potential source sufficient to cause the thyatron to fire. Such firing causes relay 218 to close and this in turn closes relay 219 to complete the circuit between the mixer and the recording head 213.

With such a trigger circuit, it will be seen that by properly locating switch 211 so that it will be closed at a time when a bucket of ore is directly within the view of the detector, and by positioning playback head 210 so that at that time, it picks up the weight signal at its maximum intensity, the output from the mixing circuit will be transmitted to the recording head 213 only when the radioactivity and mass signals are at values truly representative of the radioactivity and mass of the ore in a bucket.

Various ways of determining the mass of the ore particle have been shown, and it is within the scope of this invention to employ still other means; for example, an acoustical density detector which would provide information as to the size or weight of the particle could be employed.

There are many arrangements of detectors which are feasible. The principal requirement is that the detector produce a signal representative of the radioactivity of a discrete section of the ore without excessive pick-up of radiation from other ore sections. In some cases, it may be desirable to use a liquid phosphor in a tank surrounding the conveyor in order to obtain sufficient sensitivity. However, it is usually preferred to use plastic phosphors and these can be arranged in 2 pi or 4 pi geometry or even in other configurations. It is evident that other types of circuits can be used, the principal requirement being that the radioactivity and mass of a discrete section be combined as a ratio and that this ratio be used to govern accepting or rejecting of such section. The terms "radiation" and "radiation emitted" are used herein and synonymous with "radiation emissive" and when applied to describe a material, the terms refer to material which radiates or gives off any type of ray, particle or quantum radiation, which is susceptible of detection. It therefore includes materials having natural radioactivity, such as uranium, the rich ores, thorium, and other radioactive elements which produce radiation by induction, such as Scheelite, a tungsten ore, which will become fluorescent upon exposure to ultraviolet light.

In copending application of Roy A. Pritchett Serial Number 577,491, filed April 11, 1956, now abandoned, and the continuation-in-part thereof Serial No. 750,069, filed July 18, 1959, there is disclosed a method and apparatus for assaying a material having a fissionable component, such as uranium ore. Thus, the ore to be assayed is bombarded with thermal neutrons to cause a limited fission of the U 235 occurring in the ore. By suitable means, the number of fission events are counted and from this, together with the thermal neutron flux and the weight of the ore, and knowing the ratio of U 235 to U 238 in the ore, the amount of U 238 can be readily determined. Such an assay method finds particular use where the ratio of U 235 to its gamma emitting daughter products, such as radon and radium, is either unknown or more likely, varies throughout different portions of the ore.

Such a method and apparatus can be used in connection with the practice of the present invention. Thus, detector 13 and amplifier 30 of FIG. 12, for example, can be substituted by the detector and associated fission event counting circuit shown in the copending application so that pulses representative of the number of fission events are fed into integrating circuit 31 (FIG. 12) in substantially the same manner as pulses representative of gamma ray emission events are fed into this integrating circuit by detector 13 and amplifier 30 in FIG. 12. Reference is made to the above-identified copending application for more details of the assay method and apparatus which are incorporated herein by reference thereto.

This application is a continuation-in-part of copending application Serial Number 500,417, filed April 11, 1955, now abandoned.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made, within the scope of the appended claims, without departing from the spirit of the invention.

The invention having been described, what is claimed is:

1. The method of sorting radiation emissive ore having particles varying substantially in mass which includes dividing the ore into discrete sections which vary substantially in mass one from the other, measuring the radiation from each section, determining the mass of each section, correlating the measurement of radiation of a section to the determination of mass for the same section to obtain the ratio thereof, and causing the sections to pass to one point when said ratio of a section is above a predetermined value and to another point when said ratio is below said value.

2. The method of claim 1 wherein the ore is divided into sections with each section containing a plurality of ore particles, the particles in any one section varying substantially in individual mass.

3. The method of sorting radiation emissive ore which includes dividing the ore into discrete sections while causing the mass of one section to vary substantially from another, measuring the radiation from each section, determining the mass of each section, correlating the measurement of radiation of a section to the determination of mass for the same section to obtain the ratio thereof, and causing the sections to pass to one point when said ratio of a section is above a predetermined value and to another point when said ratio is below said value.

4. The method of sorting radiation emissive ore which includes dividing the ore into discrete sections which vary substantially in mass one from the other, measuring the radiation from each section to obtain a determination of the mass thereof, measuring the radiation from each section, correlating the measurement of radiation of a section to the determination of mass for the same section to obtain the ratio thereof, and causing the sections to pass to one point when said ratio of a section is above a predetermined value and to another point when said ratio is below said value.
5. The method of sorting radiation emissive ore which includes dividing the ore into sections varying substantially in mass one from the other, measuring the radiation from each section, generating a first signal which is a function of the radiation measurement, measuring the mass of each section, generating a second signal which is a function of the mass measurement, comparing the first and second signals to obtain the ratio thereof, and causing the sections to pass to one point when said ratio of a section is above a predetermined value and to another point when said ratio is below said value.

6. The method of sorting radiation emissive ore which includes dividing the ore into sections varying substantially in mass one from the other, generating first and second signals which are respectively a function of the radiation and of the mass of each section, combining the first and second signals to obtain the ratio thereof and causing the sections to pass to one point when said ratio of a section is above a predetermined value and to another point when said ratio is below said value.

7. The method of sorting radiation emissive ore which includes dividing the ore into sections varying substantially in mass one from the other, generating first and second signals which are respectively a function of the radiation and of the mass of each section, combining the first and second signals to obtain the ratio thereof and causing the sections to pass to one point when said ratio of a section is above a predetermined value and to another point when said ratio is below said value.

8. The method of sorting radiation emissive ore which includes, measuring the radiation and mass of an ore particle and generating separate signals which are respectively a function of the radiation and mass measurements, combining the signals to obtain the ratio thereof, and accepting or rejecting the ore particle in accordance with whether the ratio is above or below a predetermined value.

9. An apparatus for sorting ore having a radioactive component which includes, means for dividing the ore into sections varying substantially in mass, one from the other, means for measuring the radioactivity of each of such sections, means for moving said sections past the radioactivity measuring means in close proximity thereto to measure the radioactivity of each section, means adjacent said radioactivity measuring means for determining the mass of each of said sections, and means for correlating the radioactivity measurement and the mass determination to obtain the ratio of the radioactivity to mass of each of said sections whereby ore may be sorted in accordance with such ratio.

10. An apparatus as set forth in claim 9, wherein the means for determining the mass of the sections comprises a light source and a photoelectric cell spaced from the source for receiving a light beam, together with a light interrupting unit disposed between the light source and the cell, said light interrupting unit comprising a plate or a portion thereof having a hole therethrough, said light interrupting unit being actuated by the weight of the ore section for interrupting a portion of said light beam in accordance with the weight of the ore section, whereby the amount of light received by the cell is representative of the mass of said ore section.

11. An apparatus as set forth in claim 9, wherein the means for determining the mass of the ore sections is a movable member actuated by the weight of the section operably connected adjacent the radioactivity measuring means, and means actuated by said movable member for permitting the flow of electrical energy which is controlled by the weight and therefore the mass of said ore section.

12. An apparatus for sorting ore having a radioactive component which includes, means for dividing the ore into sections varying substantially in mass, one from the other, means for measuring the radioactivity of an ore section, means for moving said sections past the radioactivity measuring means in close proximity thereto to measure the radioactivity of each section, means adjacent said radioactivity measuring means for determining the mass of each of said sections, means for correlating the radioactivity measurement and the mass determination to indicate the ratio of the radioactivity to mass of said sections, a discharge conductor for receiving ore sections and means responsive to said correlating means for directing the ore into said first discharge conductor when said ratio is above a predetermined value and into said second conductor when the ratio is below said value.

13. An apparatus for sorting ore having a radioactive component which includes, a removable conveyor on which the ore particles to be sorted are deposited and carried along a longitudinal path means for depositing ore particles on said conveyor such that the mass of the deposited particles substantially varies along the length of the conveyor, a first discharge conductor adjacent the conveyor, a second discharge conductor also adjacent the conveyor, a scanning head unit adjacent the discharge conductors and having means for measuring the radioactivity of the particles moving through the scanning head unit, said unit also including means for determining the mass of said ore particles, means for correlating the radioactivity measurement and the mass determination to indicate the radioactivity to mass ratio of the particle, and movable means actuated by the correlating means for directing the measured ore particle into one or the other of the discharge conductors in accordance with the radioactivity to mass ratio of the particle.

14. An apparatus for sorting radiation emissive ore which includes means for dividing the ore into sections varying substantially in mass, one from the other, means for measuring the radiation from each section of said ore, means for moving said section past the radiation measuring means to permit said radiation measurement to be made, means for determining the mass of each of said sections, and means for comparing the radiation measurement and mass determination to obtain the ratio thereof, whereby ore can be sorted in accordance with whether or not such ratio is above or below certain values.

15. The apparatus of claim 14 wherein said moving means is adapted to receive and maintain a plurality of ore particles as one of said sections.

16. As a subcombination, means for measuring the radiation emitted from ore particles moving therepast and for generating a first signal which is a function of the measured radiation, means for determining the mass of said ore particles as they move therepast and for generating a second signal which is a function of the determined mass, and means for comparing the first and second signals so that the ore can be sorted in accordance with such ratio.

17. An apparatus for sorting radiation emissive material having varying radiation to mass ratios which includes, a radiation measuring means for measuring a signal which is a function of the radiation detected, means for measuring a mass as it is moved therepast and capable of emitting a signal which is a function of the mass, means for dividing the material into sections varying substantially in mass one from the other, means for effecting a relative movement of successive sections of said material with respect said detection device and said mass measuring means, means connected to said device and mass measuring means and responsive to the ratio of the signals therefrom to control the separating means hereinbefore recited, and separating means for the material controlled by said responsive means.

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