Feb. 14, 1950 G. A. BASTANCHURY 2,497,339

PNEUMATIC STRATIFIER

Filed July 9, 1948 2 Sheets-Sheet 1

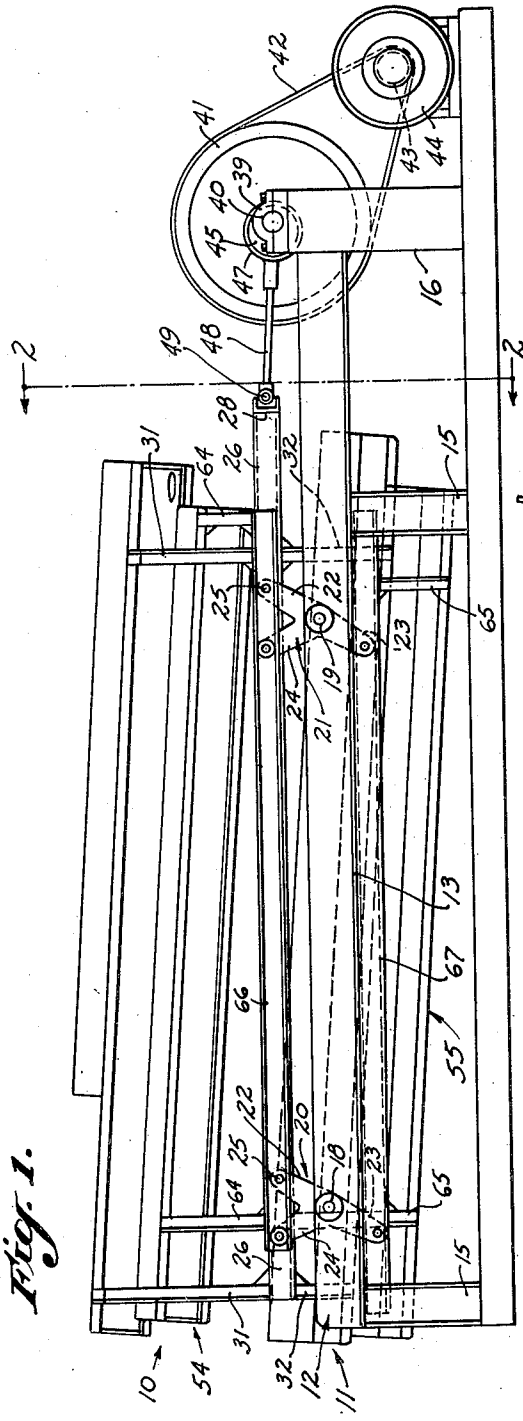


Fig. 1.

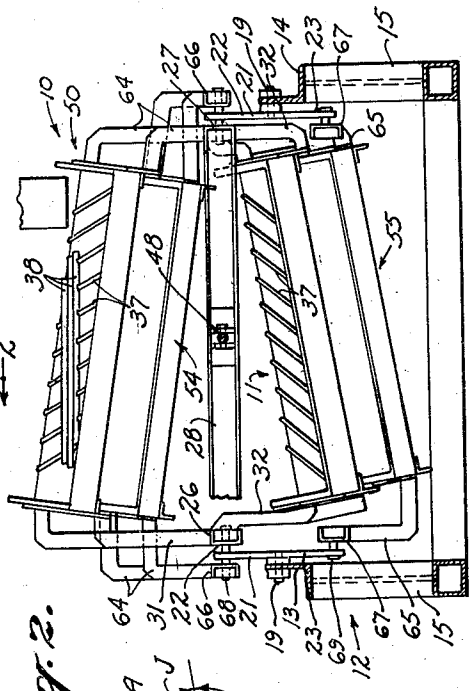


Fig. 2.

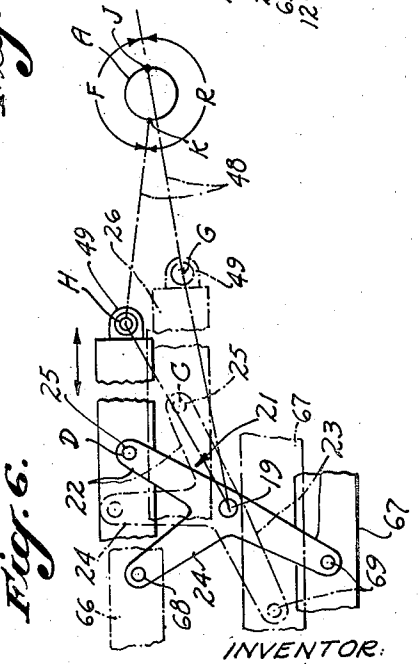


Fig. 6.

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Filed July 9, 1948 2 Sheets-Sheet 2

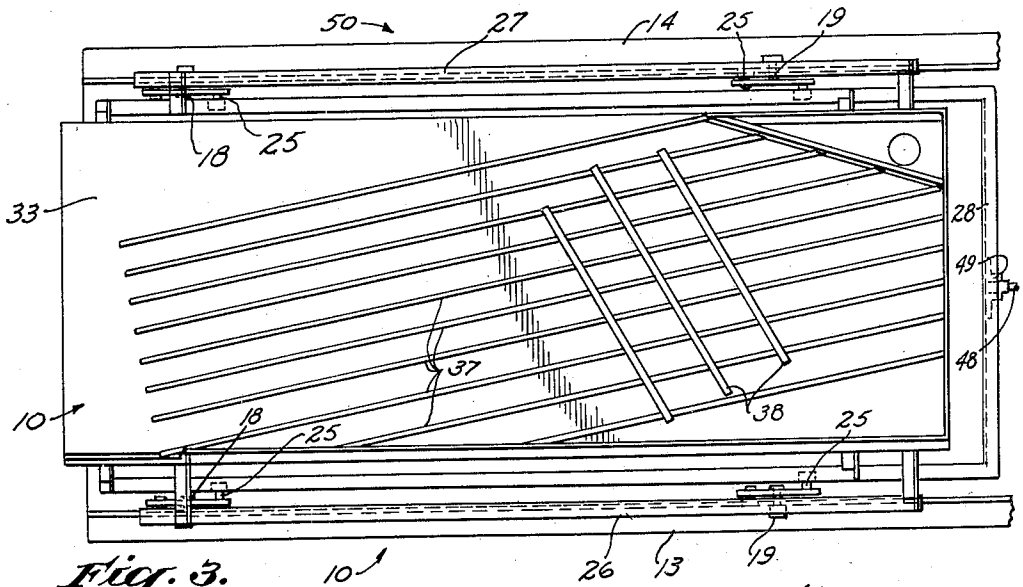
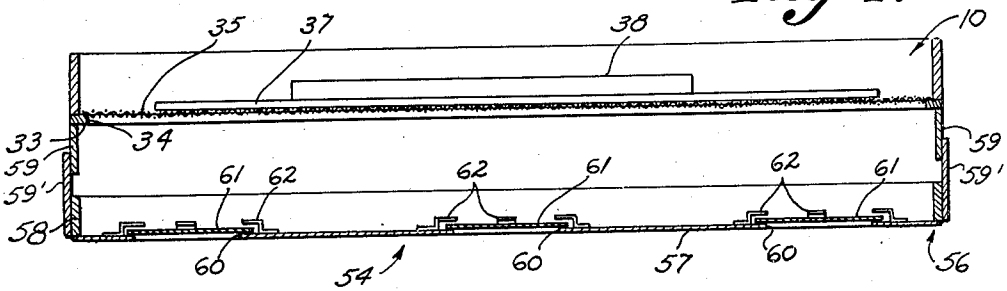


Fig. 3.

Fig. 4.



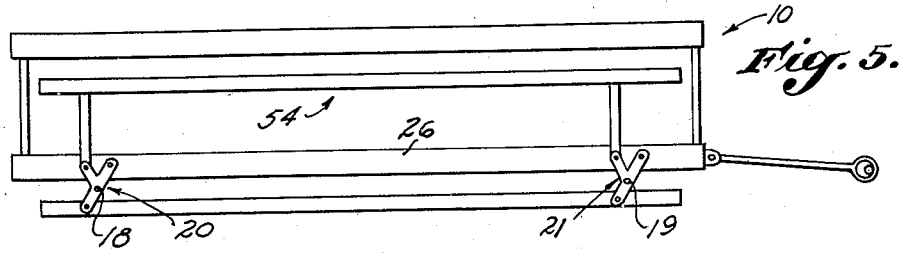


Fig. 5.

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2,497,339

PNEUMATIC STRATIFIER

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3 Claims. (Cl. 209—469)

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My invention relates generally to material handling apparatus and particularly to apparatus for moving sand, gravel, ores and like loose material. Specifically, the invention pertains to apparatus for operating upon ore-bearing rock, sand or gravel and to a novel type of operating means or mechanical motion capable of producing efficient movement of the material through the apparatus. While the present improved motion is adapted for general use in material handling equipment such as is employed in mines, road building and gravel handling operations, the following specification describes the same as embodied in an ore-concentrating machine or table which is used to separate and segregate ores from ore-laden gravel and rock.

In the processing of ores, concentrating or dresser tables or jigs are employed, these tables supporting the ore-bearing material and being capable of separating fine particles of mineral matter of different specific gravity. The supporting table is inclined in two directions and reciprocated longitudinally to shake the ore-bearing material and cause it to move longitudinally. The lighter particles, usually waste material such as the gangue, or waste material in which heavier mineral particles are embedded prior to crushing, or mixed, if the material being treated is already in finely divided state, are discharged from one side of the table, while the heavier particles are discharged from the other side and end thereof. Concentration of the ore is aided either by the presence of water or air at the top surface of the table, the water flowing continuously along the top surface during the entire operation, or the air being directed upwardly through the interstices of a mesh fabric or the like along which the material flows. In either case, the water or air provides buoyancy for sustaining the particles of the material being treated and thus aids in the movement of the material lengthwise of the inclined table.

The present invention is concerned with ore-separation tables of both the so-called wet and dry types, the tables being used singly or arranged in tandem or in multiple decks and operated from a common source of power or from individual prime movers. More specifically, my invention relates to a driving means or head motion employed for reciprocating the table to cause the material being processed to move longitudinally of the table. In prior concentrating tables such a head motion usually consists either of a rotatable crank which is connected to reciprocate the concentrating table through the medium of

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suitable linkage, or a rotatable eccentric which is operatively connected to the table by a link. In the prior machines, means are embodied in the crank motion to impart to the table a return movement which is faster than the forward movement so as to cause the material to move in the forward direction.

It has been heretofore believed necessary to effect a quick return stroke of the table, that is, a rapid longitudinal movement of the table in the direction of its lower end, in order to cause the material to feed in the opposite or upwardly inclined direction, hence the provision of such quick return motion incorporated in the table reciprocating mechanism. While such quick return motions have been in constant use for many years, the fallacy of the belief expressed above apparently has never been discovered until the present time. During extensive research and experimentation conducted for the purpose of improving existing ore-concentration tables, I discovered that when the motion was reversed, that is, when the table was propelled forwardly at a fast rate and returned at a slower rate, the rate of travel of the material up the inclined surface of the table was substantially increased. Further investigation has revealed that this increased rate of feed of the material is due to the fact that during the fast forward stroke of the table, the material is actually tossed or flung forwardly so that the particles of material roll or tumble forwardly along the surface of the table. However, it was determined that when the table was merely reciprocated in a rectilinear path, such quick forward motion was relatively ineffective in augmenting the rate of feed of the material. Further experimentation resulted in the discovery that when the table was reciprocated or oscillated in an arcuate path and a quick forward motion was imparted to the table, the increased rate of travel of the material was obtained. The oscillating motion discussed above is comparable to the motion imparted by gold prospectors to their pans during a panning operation.

Due to the relatively complicated nature of the prior quick return mechanism and the fact that the rotary movement of the prime mover is not used to greatest advantage, the rate of reciprocation of the table and the resulting rate of travel of the material thereacross are quite slow and inefficient and, as a result, the productive capacity of such machines is retarded. Since the driving mechanism is necessarily of a heavy construction, considerable power is re-

quired to obtain flow of the material along the table and it has been necessary to operate such machines independently, that is, to actuate each machine from a single heavy duty motor and mechanical head motion.

It is an important object of my invention to provide in a material handling apparatus, such as an ore-concentrating machine, means for imparting an arcuate motion to the table so as to effect a more efficient flow of the material along the top of the table.

It is another object to provide a machine, of the character referred to, which embodies a novel mechanical head motion for imparting, in addition to the arcuate movement, a reciprocatory motion to the table, said mechanism being so constructed and arranged that the table is moved at a relatively fast rate in its forward direction and at a slower rate in the opposite or rearward direction so as to cause the material to move forfardly in the direction of the fast movement. By this means, the ore-laden particles of the material are, in effect, tossed or caused to move with a rolling action, as distinguished from the usual sliding movement of the particles which is effected when a conventional, straight reciprocating motion is imparted to the table, as in prior ore-concentrating machines. Because of this more efficient motion imparted to the particles of the material, a greater quantity of the material can be processed per unit of time and the output of the machine thus greatly increased while, at the same time, a substantial reduction in the power necessary to operate the machine is effected.

Another object of the invention is to provide a mechanical head motion which is particularly adapted for use in simultaneously operating a plurality of the tables, for example, roughing and finishing tables, of the "wet" or "dry" types, arranged either in tandem or in vertically spaced relation, the "tails" or "middlings" discharging from a first table onto a succeeding table for further concentration or separation.

Another object is to provide a material-advancing or propelling motion which is highly efficient in propelling the material so that when employed in connection with a material handling apparatus in which water is used to provide buoyancy for the material, a minimum quantity of the water is necessary and the apparatus thus may be utilized in areas where large quantities of water are unavailable.

Another object is to provide a head motion of the type indicated which is especially adaptable for use in dry concentrating tables in which air is employed for providing buoyancy for the material, the motion including lever means connected to operate a bellows for forcing the air upwardly against the particles of material being propelled along the table.

Another object is to provide a concentrating table having an improved bellows, said bellows including a plurality of valves of novel construction for controlling the passage of air drawn into the bellows, said valves being efficient and positive in operation.

Further objects of my invention will become apparent from the following description and from the drawings, which are intended for the purpose of illustration only, and in which:

Fig. 1 is a side elevation of a dry ore-concentrating machine embodying the features of my invention;

Fig. 2 is a transverse sectional view, taken on line 2—2 of Fig. 1;

Fig. 3 is a plan view of the table;

Fig. 4 is an enlarged cross-sectional view through one of the bellows elements;

Fig. 5 is a schematic view of the head motion employed in the machine; and

Fig. 6 is an enlarged schematic view of the driving mechanism, illustrating the head motion imparted to the table and bellows elements.

Referring to the drawings in detail, the ore-concentrating table illustrated therein is of the dry type wherein air is employed to provide buoyancy for the material being concentrated. The machine herein illustrated, by way of example, is of a double deck type having an upper concentrating table 10, commonly termed a "rougher" and a lower "finishing" table 11. The machine has a frame 12 which includes horizontal side rails 13 and 14 supported above the floor by legs 15. The rails 13 and 14 are extended at one end and joined to a suitable head or support 16.

Toward their forward and rearward ends, the rails 13 and 14 carry pins or studs 18 and 19 on which are respectively pivoted levers 20 and 21. The levers 20 and 21 each have a normally upwardly extending arm 22, a normally downwardly extending arm 23, and an upwardly inclined arm 24 (Fig. 6). Connected to the arms 22 of the levers 20 and 21, at opposite sides of the machine, by means of pins 25 are longitudinally extending rails 26 and 27, these rails being connected at one end by a cross member 28 (Fig. 3). Through the arrangement described above, the rails 26 and 27 may be moved longitudinally in either direction, when the levers 20 and 21 are oscillated, and maintained in horizontal position. Upper and lower vertical angle-irons 31 and 32 are secured to the rails 26 and 27 and are attached to the upper and lower tables 10 and 11 so that when the rails are reciprocated, the tables are likewise reciprocated in unison.

The tables 10 and 11 are substantially alike in construction, each being in the form of a shallow box or tray having an open end and an open top portion and a bottom 33 having an aperture 34 as shown in Fig. 4. Extending across the aperture is a sheet of fabric or a screen 35 upon which the material is adapted to rest. Within the box-like structure inclined slats or riffles 37 and 38 are held, such riffles being common to concentrating tables and well known in the art. As is usual in ore-processing machines of this type, the tables 10 and 11 are inclined in both a longitudinal and transverse direction, the drawings showing the tables as inclined in the same longitudinal direction but oppositely inclined in a transverse direction. As is usual in concentrating or separating tables of the general type disclosed herein, means may be provided for adjusting the inclination of tables, such means not being herein shown. The tables 10 and 11 are adapted to be oscillated in the direction of their length under the action of a head motion, to be next described.

Rotatable in bearings 39 at the upper end of the head 16 is a transverse shaft 40 which carries a large pulley 41, the pulley being relatively heavy and thus providing a flywheel. The pulley 41 is rotated by a belt 42 from a small pulley 43 carried by the armature shaft of an electric motor 44. The transverse shaft 40 carries an eccentric 45 which has a relatively small throw, for example, approximately two inches. Surrounding the eccentric 45 is a ring 47 formed at one

end of a connecting rod 48. The other end of the connecting rod 48 is pivotally connected to a pin 49 carried by the end member 28 extending between the rails 26 and 27. By this construction, when the eccentric 45 is rotated, the rails 26 and 27 are reciprocated longitudinally and, due to the fact that they are carried by the arms 22 of the levers 20 and 21, which are pivoted on the pins 19, it will be apparent that the rails are raised and lowered during their longitudinal movement so that the rails are, in effect, oscillated in a longitudinal direction.

The motion imparted to the rails 26 and 27 and thus to the tables 10 and 11 carried thereby, will be best understood by a study of the motion diagram of Fig. 6, to which reference is now made. The circular path or orbit through which the center of the eccentric 45 revolves is designated by the circle A in Fig. 6; that portion of the circle through which the center of the eccentric 45 travels to impart a forward movement to the tables 10 and 11 is indicated by the arc F; that portion of the circle through which the center of the eccentric revolves to effect a reverse or return movement of the tables is represented by the arc R. During one revolution of the eccentric 45, the arm 22 and its pin 25 move in a curved path represented by the arc C—D and the pin 49 moves in a similar path indicated by the arc G—H.

Assuming that the connecting rod 48 is in the position indicated by the line G—J, the rails 26 and 27 will be in the rearward lower position with the pins 49 and 25 located at the respective positions G and C. When the eccentric 45 is rotated in counterclockwise direction, as viewed in Figs. 1 and 6, a forward force is exerted upon the connecting rod 48 and pin 49 so that the rails 26 and 27 are moved forwardly. Since the rails are carried by the pins 25 of the pivoted levers 20 and 21, they pivot the levers in counterclockwise direction, thus causing the pins 25 to move from C to D. In this manner, the rails and the tables carried thereby are moved forwardly and upwardly at a relatively fast rate. This movement continues until the connecting rod 48 arrives at the position indicated at H—K, at which point the direction of movement of the connecting rod is reversed.

As the rotation of the eccentric 45 is continued in counterclockwise direction and its center rotates from K to J, the pins 25 move downwardly and rearwardly from D to C and the pin 49 similarly moves from H to G. It is thus seen that during the continuous rotation of the eccentric 45, the rails 26 and 27, together with the tables 10 and 11, are oscillated forwardly and rearwardly. It is to be particularly noted by reference to Fig. 6, that in rotating counterclockwise from J to K the center of the eccentric 45 moves through a lesser arc than when it travels from K to J, so that the rails and tables are propelled forwardly at a relatively fast rate of speed and returned through the same distance at a slower rate of speed. This quick forward motion causes the particles of the material on the tables to be intermittently thrust forwardly so that they are propelled toward the higher ends of the tables, the concentrate discharging over the high side and end of the upper table 10 (Fig. 2) while the tails fall from the open end of this table. In a like manner, material, which may be the tails discharged from the upper table 10, is processed on the lower table 11.

The peculiar and highly desirable motion de-

rived through the use of my improved operating mechanism is best obtained by locating the axis of rotation of the eccentric 45 in a horizontal plane such that the proper amounts of both horizontal and vertical movement are imparted to the table. Preferably, the axis of rotation of the eccentric is disposed at a level which is between the upper and lower extremes of the arcuate path of movement of the rails 26 and 27. By this arrangement, the quick forward movement of the rails is obtained and the horizontal component of movement imparted to the rails is substantially equal to the throw of the eccentric.

As is well known to those versed in mechanics, when a pin, or the like, is moved through a quadrant by an eccentric motion, the horizontal and vertical components of the arcuate movement imparted to the pin vary throughout the entire cycle of motion. For this reason, it is essential that the pin (in the present case, the pin 49) be caused to move through that portion of the quadrant which will effect the vertical and horizontal components of movement necessary to produce the desired table motion. In the present instance, the pin 49 is moved through an arc between the point G, which is preferably located on a line G—L disposed at an angle of approximately 25 degrees with respect to the horizontal, and the point H, which is located on a line H—L disposed at an angle of approximately 50 degrees with respect to the horizontal. By this arrangement, the pin 49 is moved through approximately 25 degrees, it having been determined that this movement produces a motion in which the table is moved rapidly in a combined forward and upward direction to obtain the highly desirable material-tossing action. It will be apparent that by so locating the pin 49 and eccentric 45 at various positions relative to each other and by providing eccentrics having different eccentricity, the character of the table motion necessary to move materials of different types at desired rates can be readily attained.

It will be observed from the foregoing that the tables 10 and 11 are oscillated simultaneously and, because they are operated by the direct connection including the rod 48 and eccentric 45, they may be oscillated at a relatively rapid rate so that maximum production of the concentrate is attained. This is an important improvement over head motions previously employed and including levers and other elements which must be operated at a relatively slow rate of speed and which, for this reason, curtail the productive capacity of the machine. Moreover, since the eccentric motion is continuous, smooth performance is insured and the power required to operate the machine is consequently reduced, it being pointed out that a motor of two horsepower is sufficient to operate the double deck machine disclosed in the drawings.

In addition to propelling the particles of material longitudinally along the tables 10 and 11, the present machine also includes means for subjecting the particles to puffs of air directed thereagainst from below so as to provide buoyancy and place the lighter particles at the top of the flow sheet of material. While bellows means for directing the air against the material are quite common in the art, such machines being known as "dry" type separating or concentrating machines, the present invention contemplates an improved means for actuating the bellows, said actuating means being arranged to be operated from the head motion.

Suspended beneath the tables or decks 10 and 11 are respective bellows members 54 and 55. The members 54 and 55 are identical in construction and for this reason only the member 54, which is shown in detail in Fig. 4, will be described herein. The member 54 consists of a rectangular tray-like element 56 which has a bottom 57 and an upstanding rim or wall 58. Surrounding the perimeter of the table 10 is a rigid sleeve element 59 which is slidable vertically within a similar release element 59' surrounding the bellows element 56. When the element 56 is pushed upwardly, air within the bellows member is forced upwardly through the interstices of the pervious covering 35 and thus directed against the particles of the material being separated to provide buoyancy therefor to aid in concentrating the ore in the manner well known to those versed in the art. The bottom 57 of the bellows element 56 has a plurality of apertures 60 which are normally closed by valve-discs 61 which rest upon the upper surface of the bottom (Fig. 4), the discs being retained in a position overlying the apertures by retainer elements 62 which permit limited upward movement of the discs. By this construction, when the bellows elements of the members 54 and 55 are moved downwardly the valve-discs 61 are unseated and air enters the elements and when the elements are raised, the discs 61 become seated to prevent escape of air through the apertures and to force the air upwardly through the covering 35.

The bellows elements 56 are connected by respective vertical ties 64 and 65 to horizontal actuating bars 66 and 67 which extend longitudinally along both sides of the machine. The upper bars at each side of the machine are pivotally connected by pins 68 to the arms 24 of the levers 20 and 21 while the lower bars 67 are pivotally connected to the lower ends of the lever arms 23 by means of pins 69 (Fig. 6). It is thus seen that when the levers 20 and 21 are oscillated under the action of the head motion eccentric 45, the upper and lower bellows members 54 and 55 are alternately raised and lowered to cause pumping of air upwardly through the covering 35 of the tables 10 and 11.

It will be observed from the foregoing that my invention provides a material handling machine or apparatus which is simple in construction, economical to manufacture and highly efficient in operation. The invention embodies a novel mechanical motion, herein referred to as a head motion, which imparts an oscillatory movement to a table, or the like, to feed loose material therealong, the motion being capable of moving the table in a forward direction at a predetermined fast rate and in the opposite direction at a slower rate so as to effect a quick forward stroke tending to propel particles of the material along the table in the direction of the faster impulse. The invention further provides an improved ore-concentrating machine having an improved bellows operating mechanism which effects increased buoyancy for the material being processed and capable of producing several times the speed of movement of the material that is achieved on conventional concentrating tables. Discovery of the new principle of operating the table has made it possible to move materials on both wet and dry tables, using an eccentric speed which is only about half that heretofore used in such machines. Due to the fact that it is possible to operate a shaking table at half the usual eccentric speed, it is possible to make the tables of lighter weight and less expensive construction requiring lighter foundations.

While the improved head motion has been described herein in connection with a double deck, dry ore-concentrating table, it will be obvious that it may have other applications to use. For example, the new motion can be employed in jigs, dry and wet tables of single or multiple deck or tandem arrangement, conveyors, and digging machines. In multiple deck machines, each table may be operated independently from its own head motion, the several motions being operated from a common source of power. In such an arrangement, the tails and middlings from one machine may feed directly to the feeder end of the second and from the second to the third, and so on, the arc type of motion making these conditions possible. In practice, I have operated the eccentric motion of a jig from a 1½ horsepower motor and have determined that twenty tons of material per hour can be fed by the jig. Separating or finishing tables similarly equipped are capable of feeding four to five tons of material per hour. The new principle has also been utilized in small wet finishing tables capable of feeding a half ton per hour. The improved shaker motion may be advantageously employed in conveyor systems where the material is to be conveyed up slopes not exceeding approximately 15 per cent for distances of a few hundred feet.

While I have herein shown and described the improvements as embodied in a preferred form of construction and applied to use in specific machines, it will be apparent that various changes might be made in the structure and application to use without departing from the spirit of the invention. Consequently, I do not wish to be limited in this respect but desire to be afforded the full scope of the appended claims.

I claim as my invention:

1. In a machine for separating particles of different specific gravity in loose material, the combination of: a frame; a first rail member movable longitudinally of the frame; an oscillatable lever having three angularly related arms, the first arm of which supports said first rail member to adapt the same for oscillation therewith; a pair of vertically-spaced tables carried by said first rail member and each having a porous surface upon which the material rests and along which it is adapted to move; a pair of vertically-spaced bellows members each of which is suspended from one of said tables and adapted to force air through one of said surfaces to provide buoyancy for the lighter particles of material, each of said bellows members having a movable element; a second rail member carried by the second of said arms so as to be oscillatable longitudinally, said second rail member being operatively connected to the movable element of the upper bellows member so that oscillatory movement of said rail member is communicated to said movable element to actuate said upper bellows member; a third rail member carried by the third arm of said lever parallel to said second rail member and operatively connected to the movable element of the lower bellows member to oscillate the same; rotary operating mechanism connected to oscillate said lever, said operating mechanism being so constructed and disposed that it imparts angular movement to said lever in one direction at a faster rate of speed than in the other direction so as to cause the material to be propelled along said tables in the direction of its faster move-

ment; and power means for rotating said operating mechanism.

2. The combination defined in claim 1 in which each of said bellows members includes a pair of rigid sleeve elements defining the periphery of the bellows member, one of said sleeves being slidable within the other sleeve as said bellows member is expanded and contracted.

3. In a machine for separating particles of different specific gravity in loose material, the combination of: a frame; a first rail member movable longitudinally of the frame; oscillatable mounting means for mounting said first rail member for longitudinal oscillation, said mounting means consisting of a lever having two angularly related arms, said first rail member being carried by one of said arms and said second rail member being carried by the other of said arms, the arrangement of said arms being such that they simultaneously impart vertical movement to said first and second rail members in opposite directions; a table carried by said first rail member and having a porous surface upon which the material rests and along which it is adapted to move; a bellows member suspended from said table and adapted to force air through said surface to provide buoyancy for the lighter particles of material, said bellows member having a movable element; a second rail member carried by said mounting means so as to be oscillatable longitudinally, said second rail member being operatively connected to said movable element so that

oscillatory movement of said second rail member is communicated to said movable element to actuate said bellows member; rotary operating mechanism connected to said mounting means for oscillating the same, said operating mechanism being so constructed and disposed that it imparts angular movement to said mounting means in one direction at a faster rate of speed than in the other direction so as to cause the material to be propelled along said table in the direction of its faster movement; and power means for rotating said operating mechanism.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
373,600	Parmelee	Nov. 22, 1887
693,709	Hoefer	Feb. 18, 1902
1,319,925	Coyle	Oct. 28, 1919
1,771,240	Worthington	July 22, 1930
1,848,151	Bennett	Mar. 8, 1932
1,875,296	Friend	Aug. 30, 1932
2,195,648	Hallenbeck	Apr. 2, 1940
2,207,844	Winkleman	July 16, 1940

FOREIGN PATENTS

Number	Country	Date
374,423	Great Britain	June 6, 1932