A waste material separating apparatus and method which comprises a frame (12) and a vibratory screen deck (26). Rod elements (40) are removably extended from a transverse rail (36). The separating apparatus has an eccentric rotating shaft secured to the deck to impart vibratory motion to the rod elements. The solid material is progressively moved from the tall to short end of the frame by forward rotary motion of the rotary shaft and falls off the ends of the vibratory rod elements onto the lower tiers to decompact and break up and tumble the waste material. The finer material falls through the rod elements and is recovered within the frame while the coarse material is discharged from the short end of the frame.
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Waste Material Separating Apparatus and Method

Background of the Invention

Soil and loam screening apparatus are known in which a screening apparatus includes a frame and a pair of sloping vibratory shaker screens supported within the frame. Generally, the frame has a tail end and a short end joined by two sides and has funneling surfaces directed toward the upper shaker screen. Soil or other material to be screened is dumped onto the upper shaker screen, for example, from the shovel of a payloader, falls from the lower end of the upper shaker screen outside of the frame, while the material which is smaller than the screen of the upper frame passes through the upper shaker screen to a lower vibratory screen of smaller opening dimensions which permits coarser material to be discharged at the one short end of the frame and finer material to pass through the lower shaker screen either onto a conveyor belt or within the frame for later retrieval. Such vibratory loam and soil material screening apparatuses are described in U.S. Patents 4,197,194, issued April 8, 1980; 4,237,000, issued December 2, 1980; 4,256,572 issued March 17, 1981; and Des. 263,836, issued April 13, 1982, hereby incorporated by reference and which apparatuses are known in the industry as Read Screen-All® soil separating apparatuses (Read Screen-All® is the registered trademark of James L. Read, Middleboro, Massachusetts).

While loam and soil material are generally quickly and efficiently separated in the above-described separating apparatus, where the feed material to the apparatus comprises a wide variety of material such as that found in dumps, which would include leaves, paper bags, sticks, as well as sand, soil, rocks, twigs, cans, bottles, tires, domestic and industrial garbage and trash, and construction site debris, the separation of such material becomes much more difficult.

There are a wide variety of vibratory screening apparatus employed to screen various materials, and which vibratory screening apparatus rather than using woven screens, comprise comb or finger-like members composed of rods arranged in a series of decks over which the feed material is passed to be separated.

It is desirable to provide for the more efficient and effective separation of a wide variety of material, particularly waste material from landfill sites which include composted, recyclable, soil-impregnated waste material.
Summary of the Invention

The present invention relates to a waste material separation apparatus and method.

The invention comprises a separating apparatus and method, which constitutes an improvement on the Read Screen-All® separating apparatus and method. The apparatus comprises a frame, generally rectangularly to support the frame generally having a one tall end and an other short end and sides joining the ends. The one end of the frame and the width sufficiently high and sufficiently wide to permit the discharge on the feed plate of the frame and within the frame of waste feed material from a soil-carrying apparatus, such as a bucket of a payloader. The frame defines an inner space for the receipt of the finer material falling through the separating surface, while coarse material is discharged from the lower end of and outside the frame. The upper end of the frame includes a downwardly angled feed plate to receive waste material and to feed the waste material by gravity to the separating surface.

The apparatus includes a vibratory screening assembly comprising a downwardly sloping separating surface from the tall to the short end of the frame so as to separate waste feed material discharged into the frame into a coarse material which is discharged at the other short end of the frame, and a finer material which passes through the screening assembly, and within the frame and is removed from the frame by a payloader or by conveyor means. The apparatus includes a means to vibrate the screening assembly and generally as in the Screen-All® apparatus would include an hydraulic motor attached to a rotary shaft having an eccentric flywheel with the screening assembly mounted on springs so as to provide for a vibratory and forward rotary movement of the screen assembly.

The deck assembly comprises a separating surface with a plurality of screening decks or tiers arranged in a shingle-type array each of which decks comprise a cross frame member with a plurality of generally uniformly spaced apart, cylindrical rod elements secured at one end to the frame member and adapted for vibratory motion at the free end thereof in a vertical direction. The rod elements preferably are straight. The rod members define uniform spaces therebetween for the separation as desired of the waste feed material into a coarse material and a finer material, the free ends of the rod-like members extending over the secured section of the next lower tier or deck with the decks horizontal or angling slightly downward, so that the transport of the waste feed material moves from the tall end of the frame toward the other, short end of the frame, that is, the material transport path is downwardly so that coarse material is discharged out of the frame at the short end.
Generally, the conical, rod-like members are of sufficient size, that is, of a
diameter and strength to withstand the waste feed material dumped onto the rod-
like members. Typically, the rods may for example have a diameter of about 1/4
up to 1-1/2 inches in diameter and be spaced apart for example from about 1/2
to 8 inches and extend from about 12 to 36 inches in length. The number of
rods and the number of tiers in the vibratory surface of course may vary as
desired, but generally would comprise from at least three, and typically, three to
six upper, overlapping decks.

The rods on the deck are mounted on a cross frame, rail or bracket,
transverse member in an individual manner, that is, open end of the rod is
threaded or tapped into a cross frame support with a bracket, the bracket
extending transversely across substantially the width of the frame, and which is
vibrated by the eccentric rotating shaft to provide forward rotary and vibratory
motion to the free end of the rod. The rods are individually mounted in order to
permit easy replacement of individual rods, rather than of the entire deck
assembly, since damage is more likely to occur in the upper rods because of the
impact and greater loads imposed on the deck.

The rotary, vibratory motion of the shaker head in the screening
apparatus translates energy directly to the cross frame support members of the
deck to provide vibration for example, in a Screen-All® device, at 1200 rpms, but
may vary from 500 to 1500 rpms as desired with generally the free end of the
rods moving from 1 to 3 inches or more in a vertical plane of vibration. The
shingled array of the deck may vary, but generally it is at an angle of about 0°
(horizontal) 15°, e.g. 3° to 10°, sloping downwardly toward the short end of the
frame. The sloped angle of the deck is related to the rate in which the desired
material is openly transported directly from the tall to the short end, so that the
angle of the deck and the forward vibratory motion controls the rate of material
flow down the shingled steps of the vibrating rods. Usually, the rods are
positioned in a uniform plane, that is, are not offset, for each deck, the free ends
of the rods of one deck slightly overlying the secured ends of the rods of the
other deck.

The apparatus includes means for feeding compacted and unseparated
soil-containing landfill material onto the separating apparatus which is capable of
decomposition and separation in a thorough and efficient manner.

The apparatus includes a feed plate for material to be discharged onto its
uppermost section which will allow compacted and unseparated material to slide
down via gravity and vibration onto the high end of the frame of the material
separating apparatus composed of a high (feed) end and a low (discharge) end.
The feed plate allows the loading bucket of an excavator to empty its contents
upstream of the separating surface which allows maximum utilization of the area provided for separation. Vibration of this feed plate is induced through the rotation of the eccentric shaft mechanism located on the shaker head. Through a combination of the angle at which this device is mounted in relation to the shaker surface, e.g. 15° to 45°, and the vibration present on the feed plate, a degree of decompaction can begin through the impact between the material and the feed plate when the excavator drops its load onto the feed plate prior to the material reaching the main separating surface.

A weighted, eccentric shaft rotates within a structure outfitted for the mounting of the screening and separating surface. The relationship between the weighted, eccentric shaft and its structure must be such that a sufficient amount of vibration can be induced to allow the waste material to be lifted and thrown in a desired forward direction to cause material to move across the separating surface formed of the rods in a continuous manner for an efficient processing of waste material.

The apparatus also includes a means for providing an opening between the rods of the screening surface to allow material of a selected size to pass through the screening and separating surface by the spacing of the vibratory rods. Material passing through the surface must be allowed to do so in such a manner as to not encounter any obstruction created by the screening apparatus structure so as to allow an efficient processing of subject material.

Removable rails available with various apertures are mounted to plates which comprise part of the screening apparatus. The rails are attached to the plates by way of mounting clips which are also removable. The removable aperture rails are mounted with their length running perpendicular to the flow of the compacted waste material. These removable aperture rails are designed to withstand the forces that can be presented by loads that are dropped onto the apparatus as well as the secondary vibration intentionally induced into the screening and separating surface. A unique feature of the apparatus is that the compacted material is fed directly from the landfill onto the waste separating apparatus. This feature requires that the structure and related components be of such construction that it can resist damage from the direct loading of the feed materials onto the apparatus rather than the normal method of feeding more homogenous material using conveyors, crushers or shredders. The openings for the material to pass through are created by individually installed rods which act as bludgeons whose length run parallel to material flow attached to the removable aperture rails and are spaced apart to create any desired opening (aperture) through which material is allowed to pass.
The apparatus must include means for decompacting and separating material buried in a landfill as it is fed onto and travels across the screening and separating surface of a screening and separating apparatus.

Individually mounted rods which act as bludgeons are produced by a manufacturing process that create an elongated, cylindrical shape throughout most of their length to maintain a consistent, uniform, selected aperture parallel to the flow of material and means for mounting on one end. The one fixed end has an enlarged cross section, e.g. 10% to 25% greater, to resist the fatigue induced by the vibrational forces created when the weighted, eccentric shaft is rotated as well as to provide a means for securing the bludgeons when rotational torque is exerted while securing the bludgeons to the removable aperture rails. The bludgeons are designed to amplify the vibration created by the weighted, eccentric shaft. This unusual force that is induced into the free end of the bludgeon is one of the unique features of the invention. Wherein the few cases that a rod is used for material separating, the vibration in the rod is of such an amplitude that at best it is hoped that it will "minimize the tendency of particles to become wedged between rods and thus obstruct material flow". This invention uses the nomenclature of "bludgeon" to describe what might normally be perceived as screen rods. The force or energy imparted into the free end of these bludgeons is for the unique purpose of decompaction of the landfill material. Objects loaded onto the screening and separating surface are violently struck by the whipping action present at the free end of each bludgeon causing a breaking apart and pulverizing of compacted material resulting in a disintegration of clumps and materials which have adhered to each other while buried and soil compacted in the landfill. In order to obtain such an unusually high degree of deflection at the free end of the cantilevered bludgeons so as to cause the decompaction of the landfill material, the supporting structure must be engineered to allow the bludgeon movement without causing damage to the structure itself. This high degree of deflection, vertical rod movement of two to six inches, is not something that is required for screening, but is necessary to achieve decompaction.

The apparatus must comprise a means for overturning compacted landfill material in order to re-orient the material passing across the screening and separating surface so as to cause the separation of a maximum amount of finer material, e.g. soil, from lighter, more bulky coarse material, e.g. plastic bottles and bags.

Substantially horizontal-positioned, individual rod bludgeons are mounted parallel to material flow in a cantilevered fashion to removable rails to accommodate various apertures or openings through which finer separated
material passes after being exposed to pounding by the free end of the bludgeons are mounted to a rotationally-induced vibrating structure in a tier or stair-like fashion in groups or sections and mounted at various heights or levels. The purpose of mounting the sections at different heights from each other is to force the material as it passes along one section (being moved by the directional vibration induced by the rotating, weighted, eccentric shaft and allowing whatever finer material that is at that time stratified after decompaction by the bludgeons into the lower most section of the pile) onto the succeeding lower section to be overturned as it falls or cascades over the whipping free end of the bludgeon dropping and tumbling a substantial distance onto the fixed end of the next and lower section of rod bludgeons in the lower screening surface. The cycle is then repeated in the same aforesaid manner, causing all of the material to be repeatedly lifted, pounded, decompacted, vibrated, dropped and overturned throughout the separating process to create optimal opportunity for the maximum amount of finer material to be removed during decompacting and separating of the landfill material that is fed onto the apparatus. Additionally, a degree of decompaction is gained from the impact of the material falling from one tier or level to the next, again assisting in reaching a maximum level of productivity of the apparatus. Generally, the vertical distance from the end of one tier of vibratory rods is greater than six (6) inches and preferably the vertical distance increases from the one to the next lower tier, such as by 25% to 50% or more, to create additional impact on the waste material, e.g. 6 to 18 inches or more.

In the process of separating the landfill materials, large, heavy, solid masses can be encountered that will concentrate a great deal of weight over a relatively small number of bludgeon rods, an example being automobile engine blocks, motors, washing machines and other heavy metal objects. The bludgeon rods must therefore be capable of enduring a severe bending stress from these heavy objects without experiencing permanent deformation. The bludgeons are designed to bend from a substantially horizontal position downward on the free end to allow these heavy solid objects to slide off of the separating surface, while the bludgeon rod is flexible enough to return to its prior position and continues to perform as designed and described.

In operation, the vibration of the free ends of the cantilevered rods provides for vibratory, generally vertical up and down, motion. For example, with feed material having compost, leaves and small, organic material, the rods moving up and down strike and lift up the lightweight material, flip the material over on each tier or deck and permit the smaller material in the waste material to pass through the aperture and opening and therefore to be separated and
permitting the larger and bulkier material to move downwardly to the short end of the frame.

The separating apparatus is directed to solid waste material composed of a variety of small and bulky, heavy and lightweight waste and trash material, usually a mixture of metal, glass, plastic, soil, organic material, etc., particularly compacted, i.e. previously buried, waste material from a landfill. Such waste material from past landfills are composed of layers of trash material, each layer covered by layers of dirt or soil, which layers are composted on site and contain high amounts of moisture which causes waste material to adhere together. The waste feed is composted and contains composted adhering soil therein. The separating apparatus provides for efficient decompaction and separation of the composted soil from the waste material by the bludgeon-type action of the vibratory rods in each tier and by the progressively greater gravity fall and tumbling of the waster material as it moves progressively downward from tier to tier or deck to deck toward the short or discharge end of the frame. The bludgeoning action, gravity fall and tumbling or turn over of the waste material loosens and separates compacted soil and finer material admixed and compacted in the waste material and provides for the decompacted finer material to fall through the selected apertures or openings between the vibratory rods.

The bludgeon rods are situated in such a manner as to cause a tumbling or overturning of material as it passes from one tier to the next in a cascading manner. The free, vertically deflecting end of one array of cantilevered bludgeons moves material in conjunction with rotative action in a horizontal, forward direction towards the next lower tier and again the process is repeated. As the material drops from the free, deflecting end of an array of bludgeons, the material is flipped, tumbled or overturned as it falls causing the release or separating of finer material from coarse material. Without this tumbling action, fine material could remain on top of coarse material throughout the duration of time that any fine material has the opportunity to fall between the spaces created between the bludgeons. Bludgeon rods are designed to take a heavy load, allow material to fall between them, lift material up in the air, e.g. light enough, pulverize by repeatedly striking or bludgeoning objects, flip material over by lifting and pushing it from one tier to the next, and begin striking of waste material as it lands from the above-preceding tier. This action is repeated in each tier. The number of tiers or decks may vary as desired to provide the desired degree of decompaction and separation.

In operation, the feed waste material to be separated is discharged onto the angled feed plate where the waste material feeds by gravity onto the upper surface of the vibrating rods. The coarser material which is unable to pass
through the opening of the vibrating rods moves downwardly and is discharged outside of the frame toward the short end. Finer soil and decompacted waste material fall through the opening of the vibrating rods.

**Brief Description of the Drawings**

Fig. 1 is a perspective view from above of a waste material separating apparatus of the invention.

Fig. 2 is an enlarged perspective view of the screening surface deck of the apparatus of Fig. 1.

Fig. 3 is an enlarged side view of the deck of the waste material separating apparatus of Fig. 1.

**Description of the Embodiments**

Fig. 1 shows a compacted landfill waste separating apparatus 10 having a frame 12 closed at the one end and open at the opposite end (not shown) to define an inner space for the recovery of finer waste material. The apparatus 10 includes angled side funneling surfaces 14, 16 and 18. Funnel plate 16 acts as an elongated feed plate, for example, at an angle of about 45° to 53° and having a plate surface length of five feet or more. The feed plate 16 receives the compacted landfill waste material and is sufficiently angled and long to provide for the start of decompaction and stratification of the waste material prior to discharge by gravity of the waste material onto the screening surface 26. The apparatus 10 comprises a portable, towable, wheeled separation apparatus having a pair of wheels 20 at the one end for road transportation of the apparatus with the wheels movable relative to the frame 12, while at the other end there is a tow bar and trailer hitch 22 for towing the apparatus by vehicle and a hydraulic motor within housing 24 to provide forward rotary and vibratory motion to the screening surface 26 by an off-center, eccentric shaft mechanism as in Read patents *supra*.

The screening surface 26 is illustrated more particularly in Fig. 2 and comprises an angle using transverse spring support 28 mounted on springs (not shown) to the frame 12 with side plates 30 and 32 and having a plurality of center plates 34 secured to and extending from the spring support 28 to divide the screen surface 26 into four equal sections. The center plates 34 are contoured at the top surface to fit the plane of the screening surface 26 at each level. The center plates 34 provide additional support for support 28 during the vibratory motion of the surface 26 within frame 12. The side plates 30 and 32 are secured at the one tall end to the support 28 and have bracket spring supports 42 and 44 at the other short end which brackets are supported on springs (not shown) to the frame 12. Aperture mounting rails 36 extend between and are secured to side plates 30 and 32 by mounting clips 38. A plurality of cylindrical,
metal, flexible side bracket rods 40 are secured at the one end through bolts to the mounting rail 36. Typically, the rods have a length of three feet and at the one bolted end are about 1-1/2 inches in diameter (10% of length) and extend to the other vibrating end with a diameter of about 3/4"; the rods uniformly parallel and spaced apart, and being in the same horizontal place and spaced about one to three inches. The threaded bolting of the individual rods 40 permits the rods to be replaced individually in the event repair or replacement is required. As illustrated, the separation apparatus 10 includes a three tier deck with the other vibratory end of the rods 40 extending generally horizontally slightly over the one end of the rods 40 of the next lower tier or deck.

Fig. 3 illustrates the rods 40 in each tier in a vertical, vibratory motion illustrated in dotted lines, the vibration caused by the off-center shaft rotating forwardly the spring-mounted screening surface 26 of rods in frame 12. Typically the free end of the rod will move a vertical distance of about one to three or more inches. The free end of the rods 40 in the first upper deck or tier are mounted about six to twelve inches h1, e.g. nine to twelve inches, above the next lower of middle tier, while the rods 40 of the middle tier are mounted about 12" to 18" h2, e.g. 12" to 14", above the plane of the next and lowest tier.

In operation, compacted, soil-containing landfill waste material is discharged by a payloader shovel or bucket onto angled feed late surface 16 and permitted to slide downwardly onto the first tier of screening surface 26. The compacted landfill material is decompacted of soil by progressive, forward movement from the first, second and third tier of vibrating rods 40 which act as bludgeons to strike forcefully at the free end the solid waste material in its forward movement impelled by the forward rotary action of the off-center shaft to break up the solid material and dislodge the finer, individual material which falls between the rod apertures and into the inner space within frame 12.

The vibratory motion of the rods 40 also act to turn over and tumble the solid material as it moves from the higher to the next lower tier as illustrated by the direction waste material flow line in Fig. 3. In addition, the progressively greater vertical distance between each tier also adds impact energy to dislodge finer material from the waste material, so that the larger, bulky waste material is discharged onto the ground adjacent the short end of frame 12.

The apparatus and method as described and illustrated provides for the rapid, efficient separation of solid, soil-containing waste material, particularly compacted landfill waste material.
CLAIMS

Claim 1. A separating apparatus, which apparatus comprises:

a) a frame means having a one tall end to receive solid waste material to be separated and an other short end to discharge coarse material and defining an inner space for the recovery of separated finer material;

b) a downwardly angled feed plate means at and extending outwardly from the one tall end of the frame to receive solid waste material to be separated and to feed the waste material by gravity at the one tall end onto a vibratory separating surface means;

c) a vibratory separating surface means which comprises a plurality of separate tiers arrayed in descending downward order from the one tall to the other short end of the frame, each tier comprising a transverse mounting rail and a plurality of generally parallel, spaced apart rods having a one and other end to form an aperture between rods, the one end of the rods secured to the mounting rail and the other end of the rod free for vibratory, vertical movement, the other free end of the rods extending along the flow path of the solid waste material and over the one end of the rods in the next lower tier, the vertical distance between the other free end of the rods of at least one each tier being greater than at least one higher tier; and

d) means to provide a forward rotary movement of the separating surface means to move decompacting solid waste material progressively downwardly from the one tall to the other short end of the frame means, to cause the solid waste material to move from one tier to a lower tier to cause the other free end of the rods of each tier to vibrate in a generally vertical direction and act as bludgeons to strike the solid waste material in its downward path to dislodge finer material from the waste material and to permit the finer material to fall between the apertures into the inner space of the frame means and to discharge coarser material substantially free of finer material from the short end of the frame means.

Claim 2. The apparatus of claim 1 which comprises at least three tiers and wherein the vertical distance between the highest and next lower tier is at least about six inches and the vertical distance between the next lower and lower tier is at least about twelve inches.
Claim 3. The apparatus of claim 1 wherein the vertical distance between the free ends of the rods in each tier becomes progressively greater from the tall to the short end.

Claim 4. The apparatus of claim 1 wherein the rods at the one end have a larger diameter than the rods at the other end.

Claim 5. The apparatus of claim 1 which includes a plurality of center plate means secured to each mounting rail which center plate means divides the separating surface into a plurality of generally uniform sections.

Claim 6. The apparatus of claim 1 wherein the rods have a vertical vibrating movement at the other free end of about one-half to three inches.

Claim 7. The apparatus of claim 1 wherein the apparatus includes a downwardly angled top funneling surface about the top end of the frame and wherein feed plate means extends outwardly from the top funneling surface at the tall end of the frame to receive compacted solid waste material thereon to provide for the start of decompaction and stratification of the waste material prior to discharge of the waste material onto the vibratory separating surface means.

Claim 8. The apparatus of claim 7 wherein the means to provide a forward rotary movement vibrates the outwardly extended feed plate means.

Claim 9. The apparatus of claim 1 wherein the rods are cylindrical, tapered solid metal rods having an enlarged cross section at the one end to resist fatigue induced by the vibrational forces.

Claim 10. The apparatus of claim 1 wherein the vibratory separating surface means comprises from three to six tier with cylindrical, solid metal rod elements having a diameter of 1/4 to 1-1/2 inches, the rod elements spaced apart from about 1/2 inch to 8 inches and having a length of about 12 to 36 inches.

Claim 11. A method of separating a compacted, soil-containing solid waste material into a coarse material and a finer material, which method comprises:

a) feeding the waste material onto a downwardly angled feed plate above a separating surface means to provide for the start of decompaction of the waste material by the gravity movement of the solid waste material onto the separating surface means;

b) providing a vibratory separating surface means comprising a plurality of separate, generally horizontal, downwardly angled tiers arranged in a tension-mounted arrangement within a frame having a one tall end and an opposite other short end, the tiers having a transverse mounting rod and a plurality of rod elements having a one and other end and secured at the one end to the
mounting rail, the rod elements in each tier generally parallel and spaced apart a defined distance and in the same general plane, the vertical distance between the other free end of the rods from each tier downwardly being greater than at least one of the next higher tiers;
c) feeding the waste material from the feed plate onto the vibratory separating surface means;
d) providing a forward, vibratory movement to the separating surface means to provide for the forward movement of the waste material from the tall to the short end of the frame and along the separating surface means and to provide for the vibratory movement of the other free ends of the rod elements to act as bludgeons to strike forcefully the waste material and to decompact the waste material as it moves downwardly toward the other short end and to permit finer material to fall between the rod elements into an inner space within the frame;
e) decompacting the waste material by discharging the waste material by gravity from each tier to the next lower tier;
f) discharging decompacted solid waste material from the short end of the frame; and

g) discharging finer, separated waste material within the frame.

Claim 12. The method of claim 11 which includes progressively increasing the vertical distance between the tiers from the highest to the lowest tier.

Claim 13. The method of claim 11 which includes feeding the waste material downwardly onto the feed plate, the feed plate having a linear length of greater than three feet and the feed plate at an angle greater than about 15° to 45° to the separating surface.

Claim 14. The method of claim 11 which includes vibrating the feed plate to induce the start of decompaction of the waste material prior to decompacting the waste material on the separating surface means.

Claim 15. The method of claim 11 which includes providing a downwardly angled, upper funneling surface at the tall end of the frame and extending the feed plate outwardly and upwardly from the upper funneling surface and the frame at the tall end.
AMENDED CLAIMS
[received by the International Bureau on 11 January 1994 (11.01.94);
original claim 11 amended; new claims 16-19 added;
remaining claims unchanged (3 pages)]

Claim 3. The apparatus of claim 1 wherein the vertical distance
between the free ends of the rods in each tier becomes progressively greater
from the tall to the short end.

Claim 4. The apparatus of claim 1 wherein the rods at the one end
have a larger diameter than the rods at the other end.

Claim 5. The apparatus of claim 1 which includes a plurality of center
plate means secured to each mounting rail which center plate means divides the
separating surface into a plurality of generally uniform sections.

Claim 6. The apparatus of claim 1 wherein the rods have a vertical
vibrating movement at the other free end of about one-half to three inches.

Claim 7. The apparatus of claim 1 wherein the apparatus includes a
downwardly angled top funneling surface about the top end of the frame and
wherein feed plate means extends outwardly from the top funneling surface at
the tall end of the frame to receive compacted solid waste material thereon to
provide for the start of decompaction and stratification of the waste material prior
to discharge of the waste material onto the vibratory separating surface means.

Claim 8. The apparatus of claim 7 wherein the means to provide a
forward rotary movement vibrates the outwardly extended feed plate means.

Claim 9. The apparatus of claim 1 wherein the rods are cylindrical,
tapered solid metal rods having an enlarged cross section at the one end to
resist fatigue induced by the vibrational forces.

Claim 10. The apparatus of claim 1 wherein the vibratory separating
surface means comprises from three to six tier with cylindrical, solid metal rod
elements having a diameter of 1/4 to 1-1/2 inches, the rod elements spaced
apart from about 1/2 inch to 8 inches and having a length of about 12 to 36
inches.

Claim 11. A method of separating a compacted, soil-containing solid
waste material into a coarse material and a finer material, which method
comprises:
a) feeding the waste material onto a downwardly angled feed
plate above a separating surface means to provide for the start of
decompaction of the waste material by the gravity movement of the
solid waste material onto the separating surface means;

b) providing a vibratory separating surface means comprising a
plurality of separate, generally horizontal, downwardly angled
tiers arranged in a tension-mounted arrangement within a frame
having a one tall end and an opposite other short end, the tiers
having a transverse mounting rod and a plurality of rod elements
having a one and other end and secured at the one end to the
mounting rail, the rod elements in each tier generally parallel and spaced apart a defined distance and in the same general plane, the vertical distance between the other free end of the rods from each tier downwardly being greater than at least six inches;
c) feeding the waste material from the feed plate onto the vibratory separating surface means;
d) providing a forward, vibratory movement to the separating surface means to provide for the forward movement of the waste material from the tall to the short end of the frame and along the separating surface means and to provide for the vibratory movement of the other free ends of the rod elements to act as bludgeons to strike forcefully the waste material and to decompact the waste material as it moves downwardly toward the other short end and to permit finer material to fall between the rod elements into an inner space within the frame;
e) decompacting the waste material by discharging the waste material by gravity from each tier to the next lower tier;
f) discharging decompacted solid waste material from the short end of the frame; and
g) discharging finer, separated waste material within the frame.

Claim 12. The method of claim 11 which includes progressively increasing the vertical distance between the tiers from the highest to the lowest tier.

Claim 13. The method of claim 11 which includes feeding the waste material downwardly onto the feed plate, the feed plate having a linear length of greater than three feet and the feed plate at an angle greater than about 15° to 45° to the separating surface.

Claim 14. The method of claim 11 which includes vibrating the feed plate to induce the start of decompaction of the waste material prior to decompacting the waste material on the separating surface means.

Claim 15. The method of claim 11 which includes providing a downwardly angled, upper funneling surface at the tall end of the frame and extending the feed plate outwardly and upwardly from the upper funneling surface and the frame at the tall end.

Claim 16. The method of claim 11 which includes providing rod elements having an enlarged cross section at the one secured end.

Claim 17. The method of claim 11 which includes vibrating the separating surface means to induce vertical movement of about one to six inches at the other free end of the rod elements.
Claim 18. The method of claim 11 wherein the waste material includes heavy and lightweight material and which method includes tumbling of at least a portion of the lightweight waste material as the waste material moves downwardly one to the other tier and from the tall to the short end of the frame.

Claim 19. The method of claim 18 wherein the waste material comprises a composted, soil-containing, compacted mixture of small and bulky, heavy and lightweight material derived from a landfill and includes discharging the bulky material from the short end of the frame.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC(5) : C10G 21/02
US CL. : 209/314
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S. : 209/311, 314, 315, 319, 393, 395, 400, 420, 674

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>Y</td>
<td>US,A, 4,256,572, (Read) 17 March 1981, see entire document.</td>
<td>1-15</td>
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<td>Y</td>
<td>US, A, 3,221,877 (De Koning) 07 December 1965, see entire document.</td>
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<tr>
<td>Y</td>
<td>US, A, 4,361,240 (Davis et al.) 30 November 1982, see entire document.</td>
<td>4,9</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

Date of the actual completion of the international search: 09 November 1993
Date of mailing of the international search report: NOV 15 1993

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks
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Washington, D.C. 20231

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