This invention relates to an apparatus for reclaiming particulate material from a storage pile. In a number of industries the need exists for providing very large storage piles of particulate raw materials. For example, large installations utilizing coal, limestone, and various ores require storage piles of these bulk materials which are built up on open level ground areas. These bulk storage piles may contain several hundred thousand tons of particulate material. It is quite common to form an elongated storage pile by use of a traveling stacker which builds the pile in a multitude of layers by a boom mounted on a wheeled, stationary stacker which is able to move the particulate material along the peak or peaks of the pile as the stacker shuts back and forth from one end to the other of the elongated pile. The operation and construction of such a traveling stacker designed to feed material in layers on to a storage pile are well known and further description of such machines need not be given herein since it forms no part of the instant invention. It is a characteristic of the layered pile made up by a traveling stacker that variations in the material fed onto the pile by the stacker are distributed throughout the pile in the many layers. Consequently, material variations will be blended into a more uniform state when the material is removed from the pile by digging into and removing material from the end of the pile.

The apparatus employed to remove the particulate material from the storage pile as it is needed and deliver it to the point of use is commonly referred to as a reclaimer. Various types of machines have been developed heretofore to perform the operation of reclaiming particulate material from a storage pile. Frequently the reclaimer is a traveling machine mounted to advance toward the storage pile and remove material from the pile in a predetermined pattern of operation. With an elongated pile the machine may be mounted on rails extending along opposite sides of the pile and the reclaimer guided and supported on such rails as it advances against the end face of the pile and removes material in a predetermined pattern. In a circular storage pile the reclaiming machine may be mounted at one end to pivot around a vertical axis with the other end guided and supported on a circular track.

It will be appreciated that a layered storage pile formed on an open ground area as distinguished from material piled between side walls in a bin or other retainer will have an end face generally approximating a triangle. Depending upon the characteristics of the particulate material making up the pile the angle of inclination of the sides of the pile will vary. It will also be appreciated that the end face of the pile will have a normal angle of repose dependent upon the characteristics of the particulate material making up the pile. Not only the nature of the material forming the pile but its condition as to moisture content, particle size, range of particle size, etc., will enter into the determination of the normal angle of repose or angle of inclination which the material will assume at the sides and ends of the pile as the pile is built up by operation of the stacker.

In the reclaiming operation the material may be removed from the base of the pile by taking uniform cuts of material from the end face. With the multiple layers of material built into the pile by operation of the stacker preferably an equal amount of each of these layers will be taken from the pile by obtaining a cut of material across the pile face.

It is common practice and, indeed, most practical for the material to be removed along the base of the pile end face, thus the reclaimer digs from the base of the pile relying on gravity to supply the particulate material from the upper portions of the pile face to move down to the pile base to the digging means of the reclaimer. The removal of successive cuts across the end face of the pile is an advantage not only in that blending of a portion of each of the multitude of layers placed in the pile by the stacker will be obtained, but also in that a more orderly and effective removal of material and clean-up of the storage area can be carried out by the reclaimer.

Where the reclaiming operation is such that the material from along the pile base the characteristics of the material in the storage pile may be such that orderly and free flow of material particles from the upper portions of the pile face under the effect of gravity will not occur. Some materials tend to become dry and agglomerate. With high moisture content agglomeration may be more pronounced and, of course, at low temperatures freezing of moist material will prevent free flow down the face of the pile to the digging means of the reclaimer. This problem can result in the reclaimer continuing to remove material from the pile end face at the base of the pile until the reclaimer digging means has substantially undercut the face of the pile. The undercutting may proceed until a substantial weight and volume of material overlies the reclaimer digging means and this volume breaks loose cascading or avalanching down the face of the pile. Such occurrences are quite likely to overload or stall the digging means of the reclaimer. Shut-down of the machine may then be required until the mass of avalanching material can be removed and the digging means freed to resume its operation.

To avoid the possibility of the reclaimer digging means undercutting the pile face and thereafter being buried by an avalanching mass of material from the upper portions of the pile face, it has been proposed that the entire face of the pile or at least all of the pile face above the base where the reclaimer digging means operates be guarded or protected to prevent avalanching. This protection measures or devices are referred to as a rake or barrier. These prior proposals have generally suggested a rake having an area which generally corresponds in configuration to the triangular configuration and area of the pile end face or a rake which moves conjointly with a traversing digging means of the reclaimer.

Considering that the base of the pile may be on the order of 100 feet across and the distance to the peak of the pile along the sloped end face may be 50 to 60 feet, it will be realized that a rake to cover essentially the entire end face is not only unduly excessive but would add a substantial amount of weight to the reclaiming machine. The rake mounted to travel with the traversing digging means of the reclaimer also has its disadvantages. Since the digging means is to remove material from across the entire width of the pile base, it must follow that a rake traveling with the digging means to the extreme side limits of the pile base is ineffective and useless at the side portions of the pile base. At these side portions the rake will merely extend upwardly in the air with no material to be agitated therebeneath since the triangular shape of the pile face gives the side portions of the pile base only limited height.

Also, a rake mounted to move with the digging means of the reclaimer is necessarily restricted to following the same schedule of movement as the reclaimer digging means. The principal danger involved from avalanching of material is the area adjacent the maximum height or peak of the pile end face. This area in-
herently contains the greatest amount of material and presents the greatest danger of a large volume of material cascading down the face of the pile to interfere with or interrupt removal of the material from the base of the pile by the reclaiming digging means. Actually it is only this area adjacent the maximum height or peak of the pile that requires agitation to keep the face trim and avoid the avalanche problem. Where the digging means traverse across the face of the pile and the rake is required to move therewith, obviously the rake can make only one pass across the critical avalanche area of the pile face for each pass of the digging means. Thus inadequate agitation of the material adjacent the maximum height or peak of the pile can result and the rake will not effectively perform its function of avoiding avalanching.

It is a principal object of the present invention to provide improved apparatus for reclaiming particulate material from a storage pile.

It is also an important object of the instant invention to provide apparatus wherein particulate material may be removed from the base of a storage pile in a predetermined pattern and, with a minimum of cost and weight for the apparatus, the pile face will be effectively maintained in a trimmed condition as material is removed from the pile face.

It is another object of the instant invention to provide reclaiming apparatus wherein digging means for removing material from a pile face will traverse across the pile face and a trimmer will independently traverse across the pile face trimming the face to avoid undercutting the face by operation of the digging means.

A further object of the instant invention is to provide a reclamer for removing particulate material from a storage pile wherein a traversing digging means moves back and forth across substantially the entire width of the base of the pile and a trimmer agitates the face of the pile above the digging means and traverses across only a central portion of the pile face substantially less than the entire width of the pile base to maintain the face trimmed in a substantially uniformly sloped condition.

It is a specific object of the instant invention to provide in apparatus according to the preceding object for the trimmer to advance independently of the digging means and lead the digging means in the traversing movement of the digging means, the trimmer agitating the face ahead of the digging means so that the material loosened by the trimmer will flow downwardly to be picked up by the trailing digging means.

An object of the instant invention is to provide a reclamer for removing particulate material from a storage pile wherein a traveling bridge guide to move along rails extending along the opposite longitudinal sides of the pile carries a traversing digging means and an independently traversing trimmer both operable in traversing back and forth along the bridge and across the pile face such that the digging means and trimmer will not simultaneously be located at the center of said bridge and accordingly the maximum bending stresses to which the bridge is subjected will be lower than where the rake and digging means simultaneously exist at the mid-point of the bridge.

A specific object of this invention is to provide a reclamer for removing particulate material from a storage pile having the characteristics described in the above object and wherein for each traverse across the pile face the trimmer to advance independently back and forth agitating movement at only restricted portions adjacent each side limit of the pile base such that the material in the pile adjacent the side limits of the pile base will flow toward the side limits and a more uniform supply of material for the digging means to pick up will be made available adjacent these side limits of the pile.

The above and other objects and novel features of the instant invention will be readily apparent from the following description which is given in connection with the accompanying drawings. It is to be expressly understood that the drawings are for the purpose of illustration and are not intended to define the limits of the invention, but rather to merely illustrate a preferred embodiment incorporating the features of the instant invention. In the accompanying drawings forming a part hereof and wherein like reference numerals are employed to designate like parts:

FIGURE 1 is a perspective view illustrating the reclaiming apparatus of this invention associated with a storage pile from which material is being reclaimed.

FIGURE 2 is a cross sectional view through the bridge of the reclaiming apparatus with parts removed to better illustrate the relationship of the independent digging means and trimmer of the apparatus.

FIGURE 3 is a cross sectional view of the wheel and digging buckets thereon as they are associated with the rotary transfer table.

FIGURE 4 is a sectional view taken on line 4—4 of FIGURE 3; and FIGURE 5 is a diagrammatic view of the mounting relationship for limit switches operable in a control circuit to achieve one mode of operation for the reclaiming apparatus.

The overall assembly and relationship of the components of the apparatus may best be seen on FIGURE 1. The reclaiming apparatus is shown on this figure operatively associated with an elongated storage pile P consisting of particulate material. This pile P is contemplated as having been built up in a multitude of layers by a traveling stacker feeding the material onto the peak of the pile as the stacker moves back and forth along the length of the pile. As illustrated, the particulate material is being reclaimed from the pile by digging means removing the material from along the base of the triangular end face f of the pile. It will be understood that the pile P has a triangular cross section throughout its length with the slope of the sides of the pile being determined by the characteristics of the particulate material which makes up the pile. Also the end face f will have a natural slope with the angle of inclination being dependent upon the characteristics of the particulate material. Thus the propensity of the particles of the particular material to roll down the face of the pile establishes a normal or natural slope or angle of inclination for the face f of the pile end. The angle of inclination is essentially dependent on the characteristics of the particular material making up the pile. For effective and most efficient removal of material from the pile it is desired that this natural slope of the pile face be retained during the reclaiming operation.

The reclaiming apparatus incorporates a bridge 10 which in the embodiment illustrated extends across the width of the end of pile P. In the preferred construction illustrated this bridge is made up of a main structural steel bridge 11 and an auxiliary cross belt conveyor bridge 12. The main bridge and auxiliary bridge are interconnected by means of end frames 13 at the opposite ends of the bridge.

Each of the end frames 13 is provided with wheeled trucks 15. At least one of these trucks 15 on each end frame 13 is driven by suitable propulsion means 16. These wheeled trucks 15 engage with parallel tracks 20. The tracks 20 are supported on suitable foundations 25 to extend along the opposite sides of the pile P parallel to each other in the embodiment illustrated on the drawings. It will thus be seen that the propulsion means 16 by driving the wheeled trucks 15 will act to move the bridge toward the face f of the pile and thus bring the digging means and trimmer carried on the bridge into reclaiming relation with the material in the pile for its removal.

The main bridge 11 carries two separate carriages which are independently traversable along the length of the
bridge. To support these carriages the main bridge 11 is provided with one set of rails 25 and a second set of rails 26.

Carriage 30 is suspended beneath the main bridge 11 by hangers 31. These hangers have rollers 32 which engage the set of rails 25. A traversing drive 35 for the carriage 30 is provided associated with the hangers 31, such drive being appropriately coupled to traverse the carriage 30 back and forth along the length of the main bridge 11. This traversing drive may be connected to rotate rollers 32 and thus propel carriage 30 along rails 25, may be connected to draw carriage 30 along a length of chain which has its ends fixedly connected to the opposite ends of the bridge, or may take any other suitable form to traverse carriage 30. A control which will be described hereinafter is provided to appropriately stop and reverse the traversing movement of the carriage as it nears the ends of the bridge.

The carriage 30 supports the digging means which is operable to remove material from the face of the pile face. Material is conveyed from the face of the pile to the material conveyor, the conveyance being along the cylindrical wall of the manner inwardly of each of the digging buckets 41. The bucket is rigidly mounted on a shaft 43 and has strengthening plates 44 closing one end of the cylindrical wall of the bucket. Shaft 43 is mounted in bearings 45 bolted to the frame of carriage 30. The bucket may have a crossbar 40 which support the bucket to rotate about a horizontal axis. Shaft 43 is provided with a driving sprocket (not shown) connected through a roller chain (not shown) to drive 46 on carriage 30.

In FIGURES 3 and 4, the wheel 40 is generally cup-shaped in design with radial openings 47 in the cylindrical wall of the wheel inwardly of each of the digging buckets 41. The wheel is rigidly mounted on a shaft 43 and has strengthening plates 44 closing one end of the cylindrical wall of the wheel. Shaft 43 is mounted in bearings 45 bolted to the frame of carriage 30 and which support the wheel to rotate about a horizontal axis. Shaft 43 is provided with a driving sprocket (not shown) connected through a roller chain (not shown) to drive 46 on carriage 30.

The rotary transfer table 50 is mounted within the cylindrical wall portion of wheel 40 and includes a rotatable disc 51. The disc 51 is rotated in the direction shown by the arrow in FIGURE 4 by a drive assembly 52 beneath the disc and supported on the frame members of carriage 30. A channel 53 connected to the frame members of the carriage 30 supports a stationary guide fence 54 in a position overlying a portion of the periphery of rotating disc 51. This guide fence confines the material on the disc 51 until it is discharged from the disc of the rotary transfer table onto transfer belt conveyor 60. Also, a plow blade 55 is stationarily mounted above disc 51 to clear the material from the disc as the disc rotates. As illustrated, the disc 51 of the rotary transfer table is inclined at an angle such that the material discharged from the wheel buckets will be urged by gravity to move with the turning disc onto the transfer conveyor 60.

In some conditions, particularly where dry, more free flowing particulate materials are to be handled by the reclaiming, the rotary transfer table 50, its drive and related components may be dispensed with. In such an embodiment a chute 71 would replace the rotary transfer table the chute being mounted to receive the material from the interior of the wheel and discharge it onto the transfer conveyor 60.

The transfer belt conveyor 60 is supported on carriage 30 in a position such that it receives the material from the rotary transfer table 50 conveying it rearwardly to a point overlying the cross belt conveyor 70 mounted as described hereinafter. An appropriate drive 61 is provided for the transfer conveyor 60 mounted on the carriage 30.

The auxiliary cross belt conveyor bridge 12 supports cross belt conveyor 70 which extends along the length of the bridge. The cross conveyor bridge is also shown as supporting a catwalk 71 by means of which the operator may inspect the functioning of the apparatus during the reclaiming operation. The cross conveyor 70 is preferably provided with drives such as 72 and 73 by means of which the conveyor may be driven in either direction depending upon the mode of operation being carried out in utilization of the apparatus. Thus the material can be conducted to either end of the bridge.

At each end of the cross conveyor 70 there is provided a chute 75 pivotally connected to the auxiliary cross belt conveyor bridge. These chutes serve to confine the material as it is delivered from the end of the cross conveyor and properly direct it to the reclaim conveyor 80. In the perspective view of FIGURE 1, the chute 75 at the rear end of the cross conveyor 70 is shown raised to its inoperative position. The chute 75 at the near end of the apparatus as illustrated in FIGURE 1 is shown lowered in operation since the cross belt conveyor 70 is being driven in a direction to carry the material toward the chute at the near end of the apparatus.

To remove the material from the storage area after being reclaimed by the reclaim apparatus, there is provided a reclaim belt conveyor 80 stationarily supported at a position extending along the side of the pile P. This reclaim conveyor will extend the length of the pile and may appropriately connect with other conveyors to convey the material to the point of use. Reclaim conveyor 80 is disposed relative to the tracks 26 with the end of cross belt conveyor 70 and chute 75 overlying the belt surface of conveyor 80. Thus the material from cross belt conveyor 70 on the reclaim bridge will be delivered into reclaim conveyor 80.

Returning to the second carriage mounted on the main bridge 11, the sets of rails 26 support this second carriage 85. As in the case of carriage 30 which supports the digging means the carriage 85 is provided with rollers 86 which engage with the rails 26. An appropriate drive 87 is provided on carriage 85 to traverse this carriage back and forth along the length of the bridge. This drive may be directly connected to drive the rollers 86, may be coupled to sprockets to lengths of roller chain 88 which have their opposite ends fixedly connected to opposite ends of the bridge to draw the carriage back and forth along the bridge, or may be otherwise adapted to traverse carriage 85 along the bridge. Although two chain lengths are shown on FIGURE 2, it will be appreciated that a single chain length may be employed if the requisite traversing power can be obtained.

Carriage 85 supports a trimmer 90 by the lower end of trimmer 90 being pivotally connected to the lower end of carriage 85. The upper end of the trimmer is connected to the carriage 85 by cable 92 leading to a hoist 93 mounted on carriage 85. By means of hoist 93 the angle of inclination of trimmer 90 may be varied to adapt the apparatus to the normal angle of repose for the particuar characteristics of the material making up the pile that is being reclaimed. The trimmer 90 consists of an elongated frame supporting a plurality of spaced spikes 95. These spikes extend outwardly from the trimmer frame to-
ward the face of the pile and in operation of the apparatus are adapted to agitate the face of the pile so that the material in the upper portions of the pile face will be loosened and readily flow downwardly by gravity to be picked up by the digging means working at the base of the pile face.

It will be noted that as shown most clearly in FIGURE 2, the independent carriages 30 and 85 are so supported and constructed in relation to each other that they can pass each other in the separate traversing paths which preferably are employed in the reclaiming operation. There are definite advantages gained by the mounting of the carriages and relation of the main and auxiliary bridges as incorporated in the apparatus of this invention. The main bridge 11 can be readily constructed to have ample load carrying ability even with bridges of 100 feet or more in length. This main bridge with the carriage 30 and digging means supported beneath it is completely clear of the operations of the digging means. The independent carriage 30 with the digging bucket wheel and material transferring components on this carriage can readily be serviced as need may arise and the wheel, buckets and material transferring components can be replaced with ease in repairing the equipment. The ends of the auxiliary belts conveying bridge 12 separate from the main bridge 11 advantageously removes the necessity for the main bridge to carry the added load of cross belt conveyor 70 and the weight of the material that will be carried thereon. Thus bridge 12 can be effectively designed in accordance with more usual movable bridge design techniques.

The operational functions of the reclaiming apparatus should be apparent from the description of the various components given hereinabove. The apparatus, applied to reclaiming material from an elongated storage pile, will be moved toward the pile face 1 by drive means 16 propelling the wheeled trucks 15 along tracks 20. With the bucket wheel digging means, rotary transfer table 50, transfer conveyor 60, cross belt conveyor 70, and reclaim conveyor 80 all operative the bridge movement carries the digging wheel into digging engagement with the base of the pile. Drive 35 is energized to traverse carriage 30 along the length of the main bridge 11 and the digging wheel picks up the material as it passes across the width of the pile base. This material moves from the digging buckets onto the transfer table, thence to the cross belt conveyor, thereafter onto the cross belt conveyor and finally is discharged onto the reclaim conveyor where it may be delivered to the intended destination.

While the carriage 30 carrying the digging means traverses back and forth across the pile face, the independent carriage carrying carriage 85 is moved by drive 87 to traverse the trimmer back and forth across a central portion of the pile face. The traverse of the trimmer is preferably restricted to a limited length of the main bridge 11 since it is desired to agitate principally the material in the pile adjacent the peak of the pile where the greater volume of material exists and consequently greater danger of avalanching of the material over the bucket wheel. Thus the traverse distance for the trimmer 90 will advantageously be restricted to agitate the central portion of the pile face adjacent the peak of the pile. Depending on the demands of the type of material being reclaimed, the trimmer traverse may occur at a faster speed than the digging means traverse such that the trimmer traverses its restricted distance more than one time for each trip of the digging means. The controls to determine the traversing distance of the carriage 30 and the shorter traverse distance of the carriage 85 may be provided by limit switches 100 and trips 101 thereof. In each case the switch may be mounted on the carriage being controlled and the trip appropriately positioned on the main bridge 11. Of course, the same control action can be achieved by reversing the locations of the switch and trip, namely, by mounting the switches stationarily on the bridge and placing the trips on the carriages positioned to activate the respective switches as the carriages traverse back and forth on the bridge.

In setting up the different traverse distances for the digging means and trimmer, it will be obvious that the reversing controls, i.e., either the trips or switches depending on which is to be stationarily mounted on the bridge, will be mounted adjacent the ends of the bridge 11 for the digging means carriage and mounted inwardly from the bridge ends for the trimmer carriage. This relationship is illustrated in FIGURE 1. In any event, the tripping of the switch 100 for the digging means carriage 30 will act to reverse the direction of carriage traverse by reversing the driving direction of carriage drive 35. In the case of trimmer carriage 85, the tripping of the switch 100 for the trimmer carriage will stop the drive 87 short of the end of the bridge and set it to drive carriage 85 in the reverse direction.

It may be desired in some applications to vary the traverse speed of either or both of the digging means and trimmer in their paths of movement along the bridge. For the digging means a higher speed is generally used at the ends of the bridge where less material exists in the portions of the pile to be reclaimed may be used. For the trimmer a traversing speed that changes dependent on the amount of material to be agitated may be desired. In either case, the speed changes can simply and effectively be achieved by providing speed change switches and trips therefor respectively mounted on the bridge and carriage to be controlled so that a speed change switch will be tripped as such carriage traverses and this tripping will alter the traversing speed. The simple expedient of using switches and trips on the carriages and bridge respectively readily permits changes in the traversing limits for each carriage or in altering the pattern of the changes in traverse speed. By merely remounting the trip or switch at a new location along the bridge, depending on which element is stationarily fixed to the bridge, the end limit of the traverse can be changed or the point at which a change in traverse speed occurs can be altered.

One preferred operation in control of the traversing relationship between the digging means and the trimmer is for the trimmer carriage 85 to traverse in advance of the traversing distance of carriage 30. With the trimmer leading the digging means, the action of the trimmer in agitating the material will free it so that it flows, downwardly by gravity to be picked up by the digging means which is following the trimmer in its traversing path. When employing this mode of operation, the trimmer traverse will be appropriately stopped at the end of its shorter traversing path while the digging means continues its traverse to nearly the end of the bridge, terminating and reversing near the lateral edge of the base of the pile. With the trimmer remaining in this stopped position, the digging means will complete its traverse and reverse its direction for the return traverse. The trimmer will then be restarted in the reverse traverse direction to again lead the digging means in traverse across the face of the pile. This operating relationship will be repeated at both lateral edges of the base of the pile with the trimmer doing its most effective work in having to agitate only the major central portion or peak portions of the pile face.

This preferred traversing relationship between the digging means and trimmer traversing paths may also be simply achieved by switches and trips on the main and bridge respectively. The tripping of the switch that effects reversal of the direction of movement of the digging means carriage can also be used as a control signal to restart the trimmer carriage wherein the trimmer carriage will lead or move in advance of the digging means carriage. Alternatively, a separate switch and trip can be provided to be actuated by movement of the digging
means carriage from its traverse reverse point back to the stopped trimmer carriage and this actuation used in the control circuit to restart the trimmer carriage in a direction to lead the digging means carriage across the pile face. The independent traversal of the trimmer with respect to the digging means may be used to advantage in the traversing relationship producible by limit switch relationship diagrammatically illustrated on FIGURE 5. Before undertaking description of functioning of the various limit switches positioned in the spatial relation as shown on FIGURE 5, brief mention may be made of the objective of the traversing schedule to be obtained by the FIGURE 5 relation of limit switches.

The characteristic triangular shape of the end of the pile of particulate material which is to be reclaimed inherently presents a greater volume of material for the digging means to remove from the base of the pile face adjacent the center portion of the face. Similarly, this triangular end face presents less material for the digging means to pick up adjacent the two side limits of the pile base. The separate traversing capabilities of the trimmer carriage may advantageously be used to provide extra agitation of pile faces adjacent the side limits of the pile base to encourage material in these areas to move outward toward the side limits of the pile. This extra agitation and consequent lateral movement of the material from the pile peak toward the side limits of the pile can offer a more uniform supply of material at these side limits for the digging means to pick up. Thus, the trimmer carriage movement may be carried out to make a full pass across the end face of the pile and at each end of such pass, the trimmer carriage will be caused to move back and forth over only a restricted portion adjacent the side limit of the pile base.

In FIGURE 5, the relative distances for trimmer traversal and digging means traversal in relation to each other are shown by horizontal lines bearing the legends "Trimmer Traverse" and "Digging Means Traverse" respectively.

The end limits for the trimmer traverse are determined by the location of limit switch 110L and 110R. These switches are appropriately mounted on the reclaimer bridge to be actuated by a trip on the trimmer carriage. Inwardly of the limit switches 110L and 110R and also appropriately mounted on the bridge are limit switches 115L and 115R. These latter two switches are of a construction to be actuated only when engaged by the trimmer carriage trip when the carriage is moving in a particular direction. The direction in which each of the limit switches 115L and 115R is actuable is indicated on FIGURE 5 by the arrows 116 and 117, respectively.

Similarly, the end limits for the digging means traverse are set by limit switches 120L and 120R appropriately mounted on the reclaimer bridge to be engaged and actuated by a trip on the digging means carriage. Spaced inwardly on the bridge relative to the limit switches 120L and 120R are mounted limit switches 125L and 125R, these two switches being of a construction to be operable only when the digging means carriage is moving in a particular direction past the respective limit switch. The direction in which each limit switch 120L and 120R is actuable is shown on FIGURE 5 by arrows 126 and 127, respectively.

From the above described relationship and structural characteristics for the various limit switches as illustrated in the diagrammatic showing of FIGURE 5, the preferred mode of operation wherein the trimmer will provide extra material agitation adjacent each of the side limits of the pile face to be reclaimed, may be described. Assuming that the trimmer and digging means are both moving toward the right in their traversing direction as shown on FIGURE 5, the trimmer carriage being in advance or ahead of the digging means carriage as is preferred and as has been described hereinabove, the trimmer carriage trip will first engage and actuate limit switch 110R. In passing limit switch 115R before it reaches limit switch 110R, the trimmer carriage trip will not actuate limit switch 115R since this switch is only actuated when the trimmer carriage is moving in the direction of arrow 117.

Actuation of limit switch 110R will effect the control circuit for the trimmer traversing motor to reverse the direction of traverse of the trimmer. The trimmer thereupon moves back toward the left on FIGURE 5 toward limit switch 115R whereupon the trimmer carriage trip will actuate limit switch 110R since the trimmer carriage is now moving in the direction of arrow 117. Operation of limit switch 115R will act on the trimmer traverser motor through the control circuit to again reverse the direction of the trimmer carriage whereupon it will move back to the right on FIGURE 5 and upon the second actuation of limit switch 110R further movement of the trimmer carriage is stopped. In other words, the first actuation of the one-way- operable limit switch 115R will set the control circuit so that the subsequent and second actuation of limit switch 110R will bring the carriage to a stop.

At this point in the preferred speed and spatial relationship of movement between the trimmer and digging means, the digging means will not yet have reached the bridge location of limit switch 110R. Since the digging means carriage is moving to the right as shown on FIGURE 5, and thereby moving in the direction of arrow 127 the one-way-actuable limit switch 125R will be operated when the digging means carriage trip passes. The trimmer will remain stationary until the digging means has passed the trimmer and the trip on the digging means engages and actuates limit switch 125R. Operation of switch 125R will function through the control circuit to restart the trimmer carriage, starting the trimmer to move to the left. The trimmer carriage trip will thereafter operate limit switch 115R for a second time which will again cause reversal in the direction of movement of the trimmer carriage starting it back to the right whereafter limit switch 110R will again be operated to stop movement of the trimmer carriage. During this last mentioned movement of the trimmer carriage between limit switch 115R and 110R, the digging means carriage will have continued its traversal to the right to its end point of travel where the digging means carriage trip will engage and operate limit switch 120R. Actuation of this switch will, through appropriate controls, stop rightward movement of the digging means carriage and also cause the bridge to move forward toward the end face of the pile preparatory to the digging means making a subsequent pass across the pile face in removing material from the base of the pile face.

Following the indexing movement of the bridge toward the end face of the pile both the digging means carriage and trimmer carriage are started moving toward the left, the trimmer at this stage leading the digging means in the preferred spatial relationship as described hereinabove.

Upon the trimmer and digging means carriages passing to the left end of their traverses as viewed on FIGURE 5, the same tripping and operating movements for the trimmer and digging means which have been described as taking place at the right end of the traverse with respect to FIGURE 5 will be repeated by the successive actuation of the limit switches 110L, 115L, 120L and 125L mounted at the left end of the traversing schedule for the trimmer and digging means as shown in FIGURE 5. Since the mode of movement of the carriages under control of the four left end limit switches will be the same as already described for the right end traversing as viewed on FIGURE 5, repetition of the respective operating characteristics for this left end traversing operation should not be necessary.

Although specific mention has been made of switches and trips to obtain the control pattern desired for the car-
riage traversing, it will be recognized that various control circuits and components can be employed to obtain the carriage traversing pattern described herein. It is to be understood that the form of this invention herewith shown and described is to be taken only as a preferred example of the invention and that various changes and modifications in the arrangement of parts and interconnection of the components may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. Apparatus for reclaiming particulate material from a storage pile comprising:
   a bridge having digging means mounted thereon to be movable along said bridge and traverse the face of the pile, said bridge being mounted to move said digging means toward the face of the pile,
   a trimmer mounted to be movable along said bridge independently of said digging means and agitate the pile face to maintain the face trimmed in a substantially uniformly sloped condition as material is removed therefrom by said digging means,
   and conveying means on said bridge disposed to receive material from said digging means and deliver it to a point on said bridge for transport to a point of use.

2. Apparatus for reclaiming particulate material from a storage pile comprising:
   a bridge having digging means mounted thereon to be movable along said bridge and remove material from the base of the pile face as the digging means traverses the face of the pile, said bridge being mounted to move said digging means toward the face of the pile,
   a trimmer mounted to be movable along said bridge independently of said digging means and agitate the pile face as it traverses the face of the pile to maintain the face trimmed in a substantially uniformly sloped condition as material is removed from the base of the pile face by said digging means,
   and conveying means on said bridge disposed to receive material from said digging means and deliver it to one end of said bridge for transportation to a point of use.

3. Apparatus for reclaiming particulate material from a storage pile as recited in claim 2 wherein said digging means comprises a rotatably supported wheel having digging buckets around the periphery thereof, and said conveying means includes a cross conveyor extending along said bridge, and a rotary transfer table mounted to receive material from the wheel buckets and discharge such material onto a transfer conveyor which carries the material to said cross conveyor.

4. Apparatus for reclaiming particulate material from a storage pile comprising:
   a bridge having digging means mounted thereon to be movable along said bridge and remove material from the base of the pile face as the digging means traverses the face of the pile, said bridge being mounted to move said digging means toward the face of the pile,
   a trimmer mounted to be movable along said bridge independently of said digging means and agitate the pile face as it traverses the face of the pile to maintain the face trimmed in a substantially uniformly sloped condition as material is removed from the base of the pile face by said digging means,
   a cross conveyor extending along said bridge to transport material removed from the pile by said digging means to one end of said bridge,
   and a reclaim conveyor means associated with said cross conveyor to receive material from said cross conveyor.

5. Apparatus for reclaiming particulate material from a storage pile comprising:
   a bridge having a first carriage mounting digging means thereon to be movable along said bridge and remove material from the base of the pile face as said first carriage traverses the face of the pile, said bridge being mounted to move said digging means toward the face of the pile,
   a second carriage mounted on said bridge for movement therealong, said second carriage supporting a pile trimmer to agitate the face of the pile as said second carriage traverses the pile face and maintain such face trimmed in a substantially uniformly sloped condition,
   and a cross conveyor extending along said bridge to transport material removed from the pile by said digging means to one end of said bridge.

6. Apparatus for reclaiming particulate material from a storage pile as recited in claim 5 wherein said digging means comprises a rotatably supported wheel having digging buckets around the periphery thereof, a rotary transfer table is mounted to receive material from the wheel buckets, and a transfer conveyor is supported on said first carriage extending from the discharge from said rotary transfer table to a point overlying said cross conveyor.

7. Apparatus for reclaiming particulate material from an elongated storage pile comprising:
   a bridge having wheel means at its opposite ends, parallel tracks extending along the opposite sides of the pile to be reclaimed with said wheel means engaging said tracks to support said bridge for movement toward the end face of the pile,
   a digging means mounted on said bridge to be movable therealong and remove material from the base of the pile end face as the digging means traverses the face of the pile,
   a trimmer mounted to be movable along said bridge independently of said digging means and agitate the pile end face as it traverses the face of the pile to maintain the face trimmed in a substantially uniformly sloped condition as material is removed from the base of the pile face by said digging means,
   and conveying means on said bridge disposed to receive material from said digging means and deliver it to one end of said bridge for transportation to a point of use.

8. Apparatus for reclaiming particulate material from an elongated storage pile comprising:
   a bridge having wheel means at its opposite ends, parallel tracks extending along the opposite sides of the pile to be reclaimed with said wheel means engaging said tracks to support said bridge for movement toward the end face of the pile,
   a first carriage mounted on said bridge for movement therealong and traverse across the end face of the pile, said first carriage having digging means thereon for removing material from the pile end face as the carriage traverses the pile end face,
   a second carriage mounted on said bridge for movement therealong, said second carriage supporting a pile trimmer to agitate the end face of the pile as said second carriage traverses the pile end face and maintain the face trimmed in a substantially uniformly sloped condition,
   a cross conveyor extending along said bridge to transport material removed from the pile by said digging means to one end of said bridge,
   and a reclaim conveyor extending along one side of the pile to receive material from said cross conveyor.

9. Apparatus for reclaiming particulate material from an elongated storage pile as recited in claim 8 wherein said digging means comprises a rotatably supported wheel having digging buckets around the periphery thereof, a rotary transfer table is mounted to receive material from the wheel buckets, and a transfer conveyor support on said first carriage extending from the discharge from said rotary transfer table to a point overlying said cross conveyor.
10. Apparatus for reclaiming particulate material from a storage pile comprising a main structural steel bridge and an auxiliary cross conveyor bridge parallel to said main bridge, said main bridge having two sets of rails extending therealong to movably support separate carriages, said auxiliary bridge having a cross conveyor extending therealong, a first carriage suspended from said main bridge on one of said sets of rails to be movable along said main bridge, said first carriage having digging means thereon for removing material from the pile face as the carriage traverses the pile face, a second carriage supported on the other of said sets of rails on said main bridge to be movable along said main bridge and past said first carriage, said second carriage having a first means to traverse the pile face and maintain such face trimmed in a substantially uniformly sloped condition, means to move said digging means and said trimmer toward the face of the pile, and conveying means for transferring material removed from the pile face by said digging means to said cross conveyor on said auxiliary bridge.

11. Apparatus for reclaiming particulate material from a storage pile as recited in claim 10 wherein said trimmer is pivotally connected at its lower end to said second carriage, and means are provided on said second carriage connected to said trimmer to change the angle of inclination of said trimmer so that the desired slope of the pile face can be maintained for the specific characteristics of the particulate material being reclaimed.

12. Apparatus for reclaiming particulate material from a storage pile as recited in claim 10 wherein said trimmer comprises an elongated frame mounted on said second carriage to extend forwardly and upwardly along the inclined face of the pile being reclaimed, said frame having a plurality of spikes spaced therealong and extending toward the pile face to agitate the material as the second carriage traverses the pile face.

13. Apparatus for reclaiming particulate material from a storage pile comprising a main structural steel bridge and an auxiliary cross conveyor bridge parallel to said main bridge, said main bridge having two sets of rails extending therealong to movably support separate carriages, said auxiliary bridge having a cross conveyor extending therealong, a first carriage suspended beneath said main bridge on one of said sets of rails to be movable along said main bridge, said first carriage having a rotatably supported wheel with digging buckets around the periphery of said wheel, a rotary transfer table mounted to receive material from the wheel buckets and a transfer conveyor which carries the material from said transfer table to said cross belt conveyor, a second carriage supported on the other of said sets of rails to be movable along said main bridge and past said first carriage, said second carriage carrying a first means to traverse the pile face and maintain such face trimmed in a substantially uniformly sloped condition, and means mounting said bridges to move said digging means and said trimmer toward the face of the pile.

14. Apparatus for reclaiming particulate material from an elongated storage pile comprising a main bridge and an auxiliary cross conveyor bridge parallel to said main bridge, said main bridge having two sets of rails extending therealong to movably support separate carriages thereon, said auxiliary bridge having a cross conveyor extending therealong, wheel means at the opposite ends of said bridges, parallel tracks extending along the opposite sides of the pile to be reclaimed with said wheel means engaging said tracks to support said bridge for movement toward the end face of the pile.

15. Apparatus for reclaiming particulate material from a storage pile comprising a bridge having digging means mounted thereon to be movable along said bridge and remove material from the base of the pile face as the digging means traverses the face of the pile, said bridge being mounted to move said digging means toward the face of the pile, a trimmer mounted to be movable along said bridge independently of said digging means and agitate the pile face as it traverses the face of the pile to maintain the face trimmed in a substantially uniform sloped condition as material is removed from the base of the pile face by said digging means, drive means connected to traverse separately said digging means and said trimmer back and forth along said bridge, control means connected to control said drive means to reverse movement of said digging means at each end of said bridge so that said digging means traverses substantially the entire length of said bridge and to reverse movement of said trimmer before it reaches each end of said bridge so that said trimmer traverses a central portion of the length of said bridge substantially less than the entire length of said bridge, and conveying means on said bridge disposed to receive material from said digging means and deliver it to one end of said bridge for transportation to a point of use.

16. Apparatus for reclaiming particulate material from a storage pile as recited in claim 15 wherein said control means controls traverse of said trimmer to move in advance of the traversing movement of said digging means.

17. Apparatus for reclaiming particulate material from a storage pile as recited in claim 15 wherein said control means controls traverse of said trimmer at each end of said central portion to move back and forth through a restricted portion adjacent each side limit of the pile base.

18. Apparatus for reclaiming particulate material from a storage pile comprising a bridge having digging means mounted thereon to be movable along said bridge and remove material from the base of the pile face as the digging means traverses the face of the pile, said bridge being mounted to move said digging means toward the face of the pile, a trimmer mounted to be movable along said bridge independently of said digging means and agitate the pile face as it traverses the face of the pile to maintain the face trimmed in a substantially uniformly sloped condition as material is removed from the base of the pile face by said digging means, drive means connected to traverse separately said digging means and said trimmer back and forth along said bridge,
control means for said drive means to control the traversing operation of said digging means and said trimmer, said control means operating said drive means to traverse said digging means through substantially the entire length of said bridge, said control means further effecting operation of said drive means to traverse said trimmer through a central portion of the length of said bridge in a path substantially less than the entire length of said bridge with the traversing movement of said digging means, said control means stopping said trimmer at the end of each traverse and restarting the trimmer traverse to lead the return traverse of said digging means, and conveying means on said bridge disposed to receive material from said digging means and deliver it to one end of said bridge for transportation to a point of use.

19. Apparatus for reclaiming particulate material from a storage pile comprising a bridge having a first carriage mounting digging means thereon to be movable along said bridge and remove material from the base of the pile face as said first carriage traverses the face of the pile, said bridge being mounted to move said digging means toward the face of the pile, first drive means for said first carriage connected to traverse said first carriage back and forth along said bridge, first control means connected to control said first drive means to reverse movement of said first carriage at each end of said bridge so that said first carriage traverses substantially the entire length of said bridge, a second carriage mounted on said bridge for movement therealong and past said first carriage, said second carriage supporting a pile trimmer to agitate the face of the pile as said second carriage traverses the pile face and maintain such face trimmed in a substantially uniformly sloped condition, second drive means for said second carriage connected to traverse said second carriage back and forth along said bridge, second control means connected to control said second drive means to reverse movement of said second carriage before it reaches each end of said bridge so that said second carriage traverses a central portion of the length of said bridge substantially less than the entire length of said bridge, and a cross conveyor extending along said bridge to transport material removed from the pile by said digging means to one end of said bridge.

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