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METHOD FOR BUILDING LEVEES

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METHOD FOR BUILDING LEVEES

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12 Sheets-Sheet 9

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The construction of levees and the equipment employed therein have become quite specialized since mechanical methods first began to displace the old conventional method involving the use of mules and scrapers. Heretofore, many different methods have been employed or, at least tried out; some of these employing mechanism specially designed for the purpose and others employing particular arrangements of conventional machines.

A brief review of the more prominent methods now in use may facilitate the understanding of the present invention to be hereinafter described.

Of course, the old method of employing mules and wheel scrapers is still in use, but to a very limited extent. This method consists simply in scraping the material from the borrow pit directly to the levee, where it is deposited. It must be conceded that this method produces an exceptionally good levee, better perhaps than can be produced by known mechanical methods. This is due to the dragging of the scrapers over the material deposited on the levee, and to the tramping down of the material by the mules, thus giving a packing effect which known mechanical methods have been unable to accomplish. This method, however, is now practically obsolete due to its high cost and small capacity as compared to mechanical methods.

A mechanical method which is now commonly employed involves the use of tractors and caterpillar wagons. According to this method, material is dug either by draglines or by elevating graders and loaded into wagons. In the latter case, the elevating graders dig a swath about eight to twelve inches deep, traveling along at about one hundred and fifty feet per minute, and elevate the material by means of conveyors which discharge the same directly into the caterpillar wagons following the course of the graders. This method necessarily involves the working of the equipment in the portion of the borrow pit where the material has been excavated, and for this reason, much trouble and expense is occasioned by the tractors and wagons miring in the soft material. Where borrow pits are located along a river, as is usually the case, soft material is generally encountered at a depth of from twelve to eighteen inches.

Another method now in use is the so-called "Tower system." This method is used principally for rebuilding old levees, and for this purpose consists of a tower located on the river side of the levee, another tower on the opposite side of the borrow pit, and draglines connecting the two. A bucket is secured to the dragline for dragging material from the borrow pit to the levee. Of course, the return of the empty bucket consumes approximately 50% of the operating time. With this system it is difficult to avoid frequent and serious trouble with the cables due to obstructions in the path of the bucket, particularly during night operation or foggy weather when the operator in the tower is unable to observe the working conditions. Another serious objection to this method is that when the borrow pit consists of clay or buckshot material, it is delivered onto the levee in eight or ten yard gobs or chunks, depending upon the size of the bucket, one gob or chunk on top of another, thus causing many voids which result in the levee settling for many years after it is built.

There is still another method, which involves a circular railroad to which material is delivered by draglines and loaded into side dump cars. The material is transported to the levee site by these cars and dumped into a pit, whence it is dug by dragline and overcast into the levee. It is generally necessary to overcast this material twice, and in most instances the work must be finished by mules and scrapers. It is apparent that this method is comparatively slow and involves many handling of the material.

The purpose of the foregoing is to bring out some of the problems and operating difficulties involved in the construction of levees, together with the advantages and disadvantages of methods heretofore developed, in order that the objects and advantages of the present invention may be more readily appreciated.

The primary object of the invention is to provide an improved method and apparatus for building levees.

More particularly, it is an object of the invention to provide a method and apparatus capable of building better levees than can be built by the method and apparatus heretofore employed.

Another particular object is to provide a method and apparatus by means of which the cost of levee construction may be substantially reduced.

Other objects relate to particular features of the methods, the arrangement of the apparatus, and the advantages derived therefrom, all of which will be pointed out and fully explained in the following description of the embodiments of the invention illustrated in the accompanying drawings.

Referring to the drawings, Figures 1 to 6 inclusive are respective views illustrating a corresponding number of different...
methods and equipment layouts therefor, for levee construction work.

Figures 7 and 8 taken together illustrate on an enlarged scale a portion of the equipment 5 and arrangement of the methods and layout illustrated in the preceding figures.

Figure 9 illustrates the construction of the distributing boom conveyor employed in carrying out certain of the methods.

Figures 10 and 11 illustrate one form of feeder 6 which may be used in connection with the methods and layouts illustrated in the figures.

It is to be understood, however, that the material 7 received from the conveyor system C by the conveyor unit D is reduced to small pieces and distributed to the conveyor unit B by means of one or more excavators mounted on tracks which are driven by belts or chains.

According to the preferred method and layout of the apparatus shown in Figures 7 and 8, the material of feeders A and B is transported to the conveying units above and distributed to the conveyor unit B by means of one or more excavators mounted on tracks which are driven by belts or chains.

The conveyor unit B is provided with a series of cutter elements positioned above the conveyor belt and rotatable in opposition to the flow of material on the belt for the purpose of disintegrating the material before it is finally deposited on the levee. The conveyor system C thus prepares the material in the hoppers of the several feeder units and reduces it to relatively small sizes before being transferred to the main conveyor system. The material is then transferred to the main conveyor system from the conveyor unit D and is distributed to the conveyor units C and B by the conveyors shown in Figures 7 and 8, respectively.

The distributing unit, which will be hereinafter described with reference to a structural illustration in another view, consists essentially of a bridge on which is supported a tripper and a swinging boom conveyor, both designed to travel longitudinally of the bridge and the distributor being further capable of pivotal movement. Thus, by combining ability for longitudinal and swinging movements, the boom of the distributor is capable of reaching and effectively constructing both lateral extremities of the levee and also of filling in and building up the core, all without requiring a boom of excessive length.

The method which the above described apparatus is designed to carry out is characterized essentially by the following points:

1. Continuity of flow of material from the borrow pit into the levee.
2. Proper sizing preparation of the material to be used in building the levee.
3. Selective discharge of the material according to any predetermined plan of levee construction.
4. Discharge of the prepared material from a substantially elevated point, resulting in continuous compacting of material as deposited by increments into the levee.
5. Substantially straight line progression of the entire layout of equipment in advance of the building levee.

Point 1 above represents a considerable advantage over methods previously employed in this work, all of which involve the transportation of material intermittently or in stages from the borrow pit to the levee and also the discharge into the levee of large quantities of material frequently and almost invariably in the form of large gobs or chunks. Thus, in many cases material is placed in the levee in precisely the form in which it is removed from the borrow pit, thus resulting in the piling of gobs or chunks one on top of another with many large voids interspersed throughout the levee construction and which do eventually become closed by settling and sliding of portions of the levee construction. These difficulties are avoided according to the present method by proper preparation of the material which involves reducing it to relatively small sizes, which, together with a substantial portion of the material from a substantially elevated point, results in a natural and forceful compacting action by which the material becomes kneaded into one homogeneous mass. The practice of the improved method, therefore, produces a solid levee structure without crevices or voids of appreciable size and which will therefore not be subject to destructive and costly settlements and slippages such as have repeatedly been experienced in the construction of levees according to known methods. It has been found also that by virtue of the advantages above enumerated it is possible to use...
materials which under other practices would not be at all permissible. For example, in the practice of the new method under consideration it is possible in many cases to use very wet material which equipment is first taken and used in such a way that this, of course, gives rise to the possibility of carrying on with the construction of levees during unfavorable weather, which under other circumstances would not be possible.

10. The preferred manner of practicing the method described is to first construct the toss of the levee, in effect providing firm retaining walls. This is done by positioning the swinging boom conveyor upon the bridge so as to bring the area on which the toe is to be constructed within its range of action. This is followed by the discharge of a continuous stream of prepared material from the elevated outer end of the swinging boom distributor onto the area where the toe is to be constructed. By appropriately manipulating the swinging boom distributor, the toe is completely constructed and banded in mind that this portion of the construction involves the falling of the material through the maximum distance it will readily be appreciated that the toes of the levees so constructed will be of very fine and firm texture. The tripper mechanism and swinging boom distributor are usually moved to a point adjacent to the opposite end of the bridge and the other toe of the levee is constructed in a like manner. Then by placing the tripper and swinging boom in a central position on the bridge, material may be distributed into the central area to form the core of the levee. Having completed the toes of substantial construction, it is apparent that the core may be built up without fear of slips or slides, and in this phase of the work particularly it is possible to use either a very wet or a loose material if occasion requires, inasmuch as the core is well reinforced and held in place by the solidly constructed toes.

After completing the construction within the range of the laterally movable and swinging distributor, it is necessary to advance the entire layout of equipment by distances which may be quickly accomplished by virtue of the mounting of the conveyor and distributor units on tracks and the mounting of the remaining units on self-propelling caterpillar treads.

A variation of the above method is illustrated in figure 3 of the drawings. According to this showing, substantially the same layout of equipment is used and the corresponding units are here designated by the same reference letters distinguished by a prime mark. In this case, the entire base of the levee including the toes F and the central portion is constructed throughout the entire length of the levee or, if desired, through only a predetermined distance. The equipment progresses in an opposite direction for the purpose of constructing the top portion T of the levee. Thus, as shown in Figure 2, two distinct cuts are taken in the borrow pit, the first for building the base of the levee as the equipment progresses in one direction and the second or final cut is taken to provide material for constructing the top portion of the levee while the equipment progresses in the opposite direction. This method does not differ essentially from the one described, as in the construction of the base the toes may be first laid and the center or core thereafter filled in and on the return travel the cap on the core is constructed by first building up the portion corresponding to the toes and thereafter building the core. The practice of this method becomes necessary where the moisture in the borrow pit precludes the taking of a deep cut sufficient to afford material for completely constructing the levee. A shallow cut is first taken and used in the base and levee and the cut is when the bottom of the pit is exposed without the process may be reversed and a second cut taken to provide material for the top of the levee.

According to a third method and layout of equipment illustrated in Figure 3, there is provided a plurality of excavating units A1, a series of feeder units B1, one or more conveyors C2 arranged in end to end relation and extending in a line at right angles to the line of advance of the levee and a swinging boom distributing conveyor D2 for receiving the material gathered and transported by the foregoing equipment and controlably distributing the same to form a desired type of levee. In this form also the several units, except the excavators are mounted on tracks extending parallel with the line of advance of the levee. The excavators, of course, are mounted on caterpillar treads and are self-propelling from one point to another.

In this form the feeders B1 are also designed to afford proper preparation of the material because it is passed on to the main conveyor units C2. The prepared material is ultimately discharged into the hopper of the swinging boom distributing conveyor D2 and the latter serves to discharge the material into the levee in substantially the same manner as is described in connection with Figure 1 and with like results. Thus the material may be discharged from the elevated end of the swinging conveyor boom to build up a compact toe construction on each side and thereafter the core G is built by discharging the material centrally of the levee.

It is noted that in this third form of the boom of the distributing unit must be of sufficient length to include the entire width of the levee within its radius of action, as no provision is made for lateral movement of the distributing unit.

Figure 4 illustrates still a further method and layout of equipment designed particularly for the enlargement of existing levees, although it may be also used for the construction of levees of relatively small cross sectional area. In this case there is also employed excavating units A1, feeder units B1, conveyor units C2 and a distributing unit D3. It will be noted, however, that the distributing unit D3, instead of being positioned in advance and centrally of the levee is, in this case positioned to one side of the levee which is to be enlarged. Thus there is provided a series of units arranged in a straight line extending substantially at right angles to the line of the levee, the final unit D4, however, being capable of swinging movement and having a considerable radius of action. The reference character G4 indicates the old levee which is to be enlarged and which in reality forms the core of the new levee construction. The distributing unit D3 is in the form of a swinging boom conveyor designed to receive prepared material from the series of conveyor units C2 and distribute the same to form on one side of the levee a toe F4 which is built up and merged into the old levee construction. In some cases the enlargement on one side of the levee may be sufficient but in others it may be desired to provide a similar enlargement on the opposite side of the levee, in which case the swinging distributor D5 may be so positioned as to discharge material throughout a portion of its radius of ac-
tion onto the opposite side of the levee. Such material may then be recast by means of drag lines or the like for the purpose of forming an enlargement on this side of the old levee.

In this form of the invention portions of the equipment such as conveyor units C* may be mounted on cinder blocks instead of on tracks as in previous forms. The other units may be mounted on caterpillars as indicated. It will be understood, of course, that the feeder units B* also incorporate suitable means for preparing the material as referred to in the description.

A second levee enlargement method is illustrated in Figure 5 and involves the use of units A, B, C and D, substantially the same as the corresponding units illustrated in Figure 1, although somewhat differently arranged. In this case the bridge of the distributing unit D* is mounted on tracks arranged parallel to the line of the levee and the swinging boom conveyor operates from various positions lengthwise of this bridge and also is capable of swinging movement. The old levee is indicated at C* and the enlargement at F.

In the practice of this method the excavating units A* deposit material into the hopper of the feeder B* which in turn disintegrates the material, reducing it to appropriate sizes and feeds it on to the main conveyor unit or units C*. The material thus delivered and prepared is fed into the hopper at the end of the distributor unit D* and by means of the tripper mechanism is ultimately delivered to the hopper of the swinging boom conveyor. The swinging boom operates through an arc somewhat less than 90° rearwardly from the position in which it is shown. Thus the material may be variedly discharged from the elevated end of the swinging boom to form the toe and gradually build up the body of the levee enlargement. This method embodies many of the advantages of the methods hereinafter described, particularly in reference to the distribution of a material which is relatively finely divided and to the compacting action of such material discharged from a relatively high point. The method also, of course, provides the advantages of a continuous flow of material into the levee construction.

A method differing considerably from those hereinafore described is illustrated in Figure 6 and consists essentially of one or more excavating units A, feeder units B, a series of conveyor units C, arranged in end to end relation and in a line extending substantially at right angles to the line of the levee and a distributing unit or conveyor D mounted directly on top of the levee and extending longitudinally thereof. The unit D is track mounted so as to be capable of readily advancing step by step with the advancement of the levee construction.

According to this method the excavating units A* deposit material in the feeders B* which after suitably preparing the material discharges the same onto the belts of the conveyor units C*, by which it is carried up to the unit D* position on top of the levee. This unit is so positioned as to discharge the material slightly in advance and centrally of the completed portion of the levee, thus building up the partial portions of the levee structure. Obviously this method possesses many of the advantages of those hereinafore described, particularly the preparation of the material and the continuous transportation thereof from the borrow pit to the building portion of the levee. It will be noted, however, that this method involves a considerable amount of handling of the material after it reaches the levee site as compared with those methods in which the material is distributed in a flexible and continuous manner by swinging boom distributing units.

Figures 7, 8 and 9 illustrate the general character of the distributing units of the methods illustrated in Figures 1, 2 and 3. Thus referring to Figures 7, 8 and 9 consists of a bridge d having tracks d* on which are mounted a tripper unit d* and a swinging boom distributor unit d2. These two units are connected by a detachable connecting link d3 which maintains them in proper cooperative connection with the discharge end of the tripper conveyor d4 in position to discharge material into the hopper d6 of the swinging boom distributor. From the hopper d5 material is discharged directly onto the belt d6 of the swinging boom. The tripper d2 and the swinging boom distributor are capable of being moved lengthwise of the bridge d4, thus bringing the lateral limits of the levee within range of the relatively short boom of the distributing unit. Referring to Figure 7 there is shown in dotted outline one of the many possible positions of the tripper and distributor on the bridge d4.

Referring particularly to Figure 9 it will be noted that the swinging boom of the distributor d2 has a rearward extension which is suitably counterweighted to compensate for the weight of the boom. This rearward extension is of such length that the boom is not free to rotate throughout a complete circle but is limited by reason of the interference of the tripper with the rearward extension of the boom. It is in many cases desirable that the boom be rotated 180° in order that it may discharge material rearwardly of the bridge d for the purpose of filling in to permit the laying of tracks. For this purpose the tripper unit d2 and distributing unit d2 are connected by the link d which permits of separation of these two units when occasion requires. Thus by disconnecting the link d the distributing unit d2 may be moved laterally far enough to permit free movement of the boom through 180° after which the two units can then be reconnected and the distributing unit d2 can be used for the purposes above indicated.

An alternative arrangement designed to permit use of the distributing unit for filling in land in advance of the bridge d to facilitate the laying of tracks is illustrated in Figure 16. In this figure the tripper framework, particularly the inclined frame No. 5 and the vertical frame No. 7, are arranged to permit the swinging of the boom through 180°. Thus it will be observed that there is ample clearance in this arrangement for the passage of the counterweighted rearward extension of the boom beneath the inclined portion of the tripper unit. In view of this construction, the tripper and distributor units are permanently connected in spaced operative connection.

One of the most important units in each of the methods above described is the feeder unit which receives material from the excavating units and after suitably preparing the material deposits it on the connected series of conveyor units.

One form of feeder is illustrated in Figures 10 and 11 wherein the feeder B is shown to consist of caterpillar supporting treads b1, a hopper b2 for receiving material from the excavators and an inclined conveyor b3 for carrying material to
the transversely extending conveyor unit C. In order to insure centralized loading of the belt of the conveyor units C, there is provided a pivoted deflecting plate b* positioned in advance of the discharge end of the conveyor b*. The material carried upwardly by the conveyor b* strikes the pivoted deflector b* which tends to load the material centrally on the conveyor belt.

A power operated screw and nut adjusting device b* is provided for securing or loosening the discharge end of the conveyor b* as may be required by conditions.

For the purpose of disintegrating the material discharged into the hopper b* there is provided a power driven jack shaft b* to which is secured a series of cutters b*. This shaft is arranged to rotate in a counter-clockwise direction, thus causing the cutters b* to move in opposition to the direction of movement of the conveyor belt b*.

Hence, the material carried upwardly by the belt b* will come into engagement with the cutters b* and will be continuously retarded or held back until the cutters have accomplished their purpose of reducing the material to sizes sufficiently small to pass by the cutters. These cutters, as indicated in Figure 11, are spaced lengthwise of the shaft b* and are also arranged in staggered anoxic distance circumferentially. Material deposited into the hopper b* of the feeder is in many instances in the form of one or several very large chunks or gobs, and it is essential that these be reduced to relatively small sizes before being introduced into the levee for raising or carrying. This is accomplished in a satisfactory manner by the disintegrating mechanism forming part of the feeder unit just described.

An alternative and preferred form of feeder unit is illustrated in Figures 12 to 15 inclusive. The feeder H here shown consists of an endless bar type of conveyor made up of a plurality of bars h*. This conveyor moves in the direction indicated by the arrow in Figure 14 and discharges material over the left hand end thereof directly onto the belt of a conveyor unit C on which the feeder is supported. Referring to Figure 15 it will be observed that longitudinal tracks are provided on the lateral edges of the conveyor unit C and that the feeder H is provided with suitable wheels h* supported by these tracks. A motor h* is provided which through suitable transmission mechanisms is arranged to drive the feeder H and also to propel the feeder lengthwise of the conveyor C when occasion requires. Positioned in spaced relation to the discharge end of the feeder conveyor is a vertical abutment plate h* and carried by this plate are two knives or cutters h* These cutters h* are arranged at a substantial angle to the vertical and in laterally spaced relation. Thus, a large lump of material discharged from the conveyor falls directly onto the knives h* and is supported thereby until suitably disintegrated by the means now to be described.

Certain ones of the bars h* of the conveyor are provided with cutters h*. These cutters are of elongated form arranged to be freely journalled on the bars h* and to engage adjacent bars to maintain them in operative position. Thus, the cutters h* extend vertically upward on the load carrying travel of the conveyor and depend downwardly on the return travel of the conveyor as indicated clearly in Figure 14.

A portion of the material discharged onto the bars h* of the conveyor will pass between these bars and fall directly onto the belt of the conveyor C as positioned therebeneath. The larger material will be retained on the bars, although having been somewhat disintegrated by falling onto the several cutters h* and will be conveyed to the proper point of discharge where material will fall upon the spaced cutters h*. Large portions of material will remain on the cutters h* until such time as the continuous passage of the cutters h* result in sufficiently disintegrating the material to permit its passage through the discharge space and onto the belt of conveyor C. It will be noted that the cutters h* are arranged in staggered relation providing four series of cutters, two series of which operate in the space between the cutters h* and the other two of which operate in the space outwardly of the two cutters h*.

The result of this arrangement is to provide for adequate disintegration of all material before permitting it to pass on to the main conveyors.

A further feature of the feeder shown in Figures 12 to 15 inclusive is the provision designed particularly for the handling of relatively fine material. For this purpose there is provided a series of plates h* loosely carried by certain of the bars h* and designed to rest upon adjacent bars. These plates effectively block off any desired portion of the spaces between the several bars, thus retarding the flow of finely divided material into the hopper of the feeder unit which would result in substantially the entire quantity of material passing immediately through the feeder conveyor and onto the belt of the main conveyor C. This would result in an overload on the main conveyor C and also in extremely uneven loading of the belt of the main conveyor unit C. For example, if something of this character were not employed, the dumping of a large bucket of finely divided material into the hopper of the feeder unit would result in substantially the entire quantity of material passing immediately through the feeder conveyor and onto the belt of the main conveyor C.

Thus, it is seen that the arrangement of the present invention is not limited to the disclosure herein set forth and many modifications may be used in any desired numbers to accomplish the purposes herein set forth. The particular arrangement shown is merely for purposes of illustration.

In Figure 17 there is illustrated a further embodiment of the invention, particularly designed for enlarging and rebuilding old levees. Thus, there is shown an excavating unit A adapted to discharge into a feeder unit B positioned on one of a series of aligned conveyor units C which extend at right angles to the levee. The units C, as shown, are provided with supports E, although they may be stack mounted as shown in some of the preceding figures.

The last unit C* of the series is positioned on one of the lateral inclined surfaces of an old levee, with its discharge end positioned to deliver material onto a conveyor unit D which extends longitudinally on top of the old levee. A swinging boom distributor H is positioned adjacent the discharge end of unit D and is adapted to receive material therefrom and distribute same to carry out the desired reconstruction or enlargement work.

The old levee is indicated at F and there is
shown as having been constructed, an enlargement G6. In the particular case illustrated the enlargement is of uniform character, extending the width of the levee. It should be understood, however, that any desired reconstruction or enlargement plan may be carried out with the equipment and by the method described.

The feeder units of this and other methods described are preferably of the type illustrated in Figures 12 to 15 inclusive, hereinabove described. Thus, all of the methods are characterized by special preparation of the material for levee building purposes.

One of the outstanding objections to levee construction methods heretofore practiced or proposed is that they all contemplate the depositing of large lumpy material into the levee. This invariably results in a levee construction which will eventually slip, slide or settle, owing to the numerous large voids and crevices occasioned by the dumping of one chunk on top of another. Such methods also present a very serious problem of quantities of organic matter being placed into the levee undetected because of being incorporated in the large lumpy chunks of which the levee is built. The inevitable decay of such matter results after a period of time in a defective levee which must be reconstructed.

Hence, the proper preparation of material for levee building is perhaps the most important step in a successful method for this purpose. According to the present invention in its various forms, this is satisfactorily and economically accomplished by passing all material through a disintegrating apparatus which reduces it to appropriate size for introduction into the levee and which also exposes for separation all organic substances which may be embodied in the material taken out of the borrow pit. Thus, in the practice of the various methods according to the present invention, the material taken from the borrow pit is suitably reduced in size for introduction into the levee and in this connection it may be mentioned that the particular size of the material may be carried out to meet any desired specifications laid down for the construction of a levee.

The invention further contemplates as an important step in the various methods disclosed the systematic removal of all objectionable substances from the disintegrated material as it passes in a continuous stream along the series of conveyor units toward the levee. Thus, the various main conveyor units are in effect picking tables at which men are stationed at suitable intervals for the purpose of removing all undesirable matter. This process is readily carried out with a small amount of labor and is facilitated by the normal turning and tumbling of the material as it travels along the conveyor units and as it is discharged from one unit onto the end of an adjacent unit. During the entire course of travel of the material along the main conveyor system, full opportunity is afforded for the complete removal of objectionable matter. Thus the matter as it reaches the levee is an accurately processed material, perfectly suited for the work it is to perform.

A further important feature of the invention in its various aspects is the continuity of operations. According to each of the several methods described, the material flows in a continuous and a substantially uniform stream from the borrow pit directly into the levee. This is in reality the keystone of the most rapid and efficient levee building method that has yet been devised. Of the many methods heretofore used or suggested, all involve the intermittent handling of large quantities of material from the borrow pit to the levee, either by dredge, or by levee-like stages. Thus, the method herein disclosed may be aptly described as the first truly mechanized operation for levee construction. The material flows in a continuous unbroken stream in relatively small quantities at any given point and is continuously discharged into the levee like a continuous uniform flow in relatively small increments, but by virtue of the continuity of operation these methods will result in the handling of quantities of material per hour or per day far in excess of anything heretofore accomplished.

In relation to the structural character of the completed levee, a further feature of outstanding importance is the discharge of the processed material from a relatively high point represented by the discharge end of the swinging boom distributor resulting in a natural compacting action as the material falls by increment by increment into the levee. The material thus becomes kneaded into a homogeneous mass, eliminating all voids and crevices and forming an extremely solid and durable levee. In this respect, the importance in construction of the toes of the levee and in relation to the character of material to be handled. Thus, in many cases it is necessary to work with relatively wet material, which, if not processed as herein described, and if not so kneaded into a homogeneous mass, would be entirely unsuitable for levee building purposes.

It will be noted also that the equipment described in relation to the various methods herein disclosed is adapted for the handling of the entire range of materials encountered in levee building work. Thus the feeders may be conditioned for the handling of fine, sandy material or of very coarse material, either wet or dry. This is of particular advantage in that it permits of continuous operation in a large measure irrespective of weather conditions encountered or of changes in one type of material to another as the work progresses. It is worthy of mention also that the methods of the present invention achieve entirely new standards in the matter of labor costs. The work being so completely mechanized it requires a very small amount of labor as compared to methods heretofore used.

Among the advantageous mechanical features of the present method and apparatus is the substantially constant power requirement. There are no peak loads such as exist in some of the known methods. Another important feature is the large per hour capacity due to the handling of small quantities of material continuously, as distinguished from the discontinuous handling of large quantities and the consequent loss of time in the transmission of empty equipment. The flexibility of the present apparatus is also worthy of note. If an obstruction is found in the normal line of operation, it is a very simple matter to so arrange the conveyor units as to avoid it. These units need not be in alignment. The excavators may also be readily manipulated to avoid obstructions.

The word continuous as used in the specification and claims is intended to mean unbroken, uninterrupted, or without time interval and, of course, has reference to normal operating conditions. From the borrow pit stream from the borrow pit directly into the levee. This is in reality the keystone of the most rapid and efficient levee building method that has yet been devised. Of the many methods heretofore used or suggested, as distinguished from
an interrupted flow such as a succession of
distinct loads or quantities with intervening
intervals of time and space. This meaning is also
intended to apply to the distribution of the ma-
terial at the levee site, the material being de-
posed upon the levee in a continuous stream, as
distinguished from the depositing of successive
loads or quantities, as in other methods.

The expressions, "unworked ground", or "un-
worked portion of the borrow pit" have reference
to that ground or that portion of the borrow pit
from which material has not been taken to be
placed in the levee. The term "borrow pit" has
reference to the entire area from which mate-
rial has been or is to be taken for construction
of the levee.

It is to be understood that all reference to and
representation of particular mechanisms are for
purposes of illustration only and that the inven-
tion embraces all manner of mechanism which,
broadly, is functionally equivalent of that shown
and described. For example, the cradle-like ex-
cavation shown may be replaced by shovels, power
hoes, trench diggers, or any other form of exca-
vation and loading equipment. Likewise, the con-
veying equipment may be of the belt, flight,
bucket, or any other suitable type. Also, any de-
sired type of distributing unit may be employed.

Claim:
1. The method of building levees which com-
prises removing material from a borrow pit, dis-
integrating the material, continuously and uni-
formly moving the material to the site of the
levee, depositing material along zones following
the opposite longitudinal edges of the levee site
to form the toes of the levee, and then depositing
material between the toes to form a core portion
of the levee.
2. The method of building levees which com-
prises excavating material from a borrow pit,
moving the excavated material to the levee site,
depositing material along one longitudinal edge
of said site to form one toe of the levee, then
depositing material along the other longitudinal
edge of said site to form a second toe, and finally
depositing material between said toes to form the
core of the levee.
3. The method of building levees which com-
prises excavating material from a borrow pit,
moving excavated material from the borrow pit
to a location on the levee site in advance of the
working face of the building levee, and control-
lably distributing the material to form first a toe
portion on one side of the levee site, then a toe
portion on the other side of the said site, and
finally the core portion between the said toe por-
tions.
4. The method of building levees which com-
prises excavating material from a borrow pit,
moving the excavated material to the levee site,
first constructing the base portion of the levee
by depositing material along zones following the
longitudinal edges of the levee site to form toes
and then depositing material between the toes
to complete the base, and finally constructing
the top of the levee by depositing material on
the top of the base along zones following the
longitudinal edges of the same to form new toes
and then depositing material between the new
toes to complete the levee.
5. The method of building levees which com-
prises excavating material from a borrow pit,
construing the base portion of the levee by
moving excavated material to the levee site in
advance of the working face of the building levee
and controllably distributing the material along
zones following the longitudinal edges of the
levee site to form toes and then along the space
between the toes to complete the base, and finally
constructing the cap of the levee by moving ex-
cavated material to the top of the levee base and
controllably distributing the material from said
top along zones following the longitudinal edges
of the base to form new toes on the base and then
between the new toes to complete the levee.
6. The method of building levees which com-
prises excavating material from a borrow pit,
uniformly sizing the excavated material by sep-
arating fines from lumps, breaking up the lumps
and returning the disintegrated material to the
fines, moving all of the material to the levee site,
and continuously and uniformly distributing the
material from in advance of the working face
of the levee.
7. The method of building levees to prevent
the formation of voids which will result in slips,
slides and excessive shrinkage comprising remov-
ing material from a borrow pit, uniformly disinte-
grating the oversize lumps in the material, con-
tinuously moving the material to a location on
the levee site in advance of the working face of
the levee, removing decayable matter from the
material while being moved to the levee site, and
distributing the material in relatively small in-
crements from an appreciable height above the
levee site to cause the material to be compacted
into a homogeneous mass as it falls into place in
the building levee.
8. The method of building levees to prevent
the formation of voids which result in slips, slides
and excessive shrinkage comprising excavating
material from a borrow pit, continuously mov-
ing said material to a location on the levee site
in advance of the working face of the building
levee, continuously and uniformly distributing
the material from said location on the levee site
until a desired portion of the section of the levee
has been completed, and moving the location of
distribution transversely of the levee site as many
times as is necessary to successively form the
remaining portions of the section of the levee.
9. The method of building levees which com-
prises excavating material from a borrow pit, uni-
formly sizing the excavated material by separat-
ing fines from lumps, breaking up the lumps
and returning the disintegrated lumps to the fines,
moving all of the material to a location on the
levee site in advance of the working face of the
building levee, continuously and uniformly dis-
tributing the material from said location on the
levee site until a desired portion of a section of
the levee has been completed, and moving the
location of distribution transversely of the levee
site as many times as is necessary to successively
form the remaining portions of the section of the
levee.

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