March 28, 1967 A. PERRY ETAL 3,310,893

COMBINATION EXCAVATING AND TRIMMING MACHINE

Filed Dec. 27, 1965 5 Sheets-Sheet 1

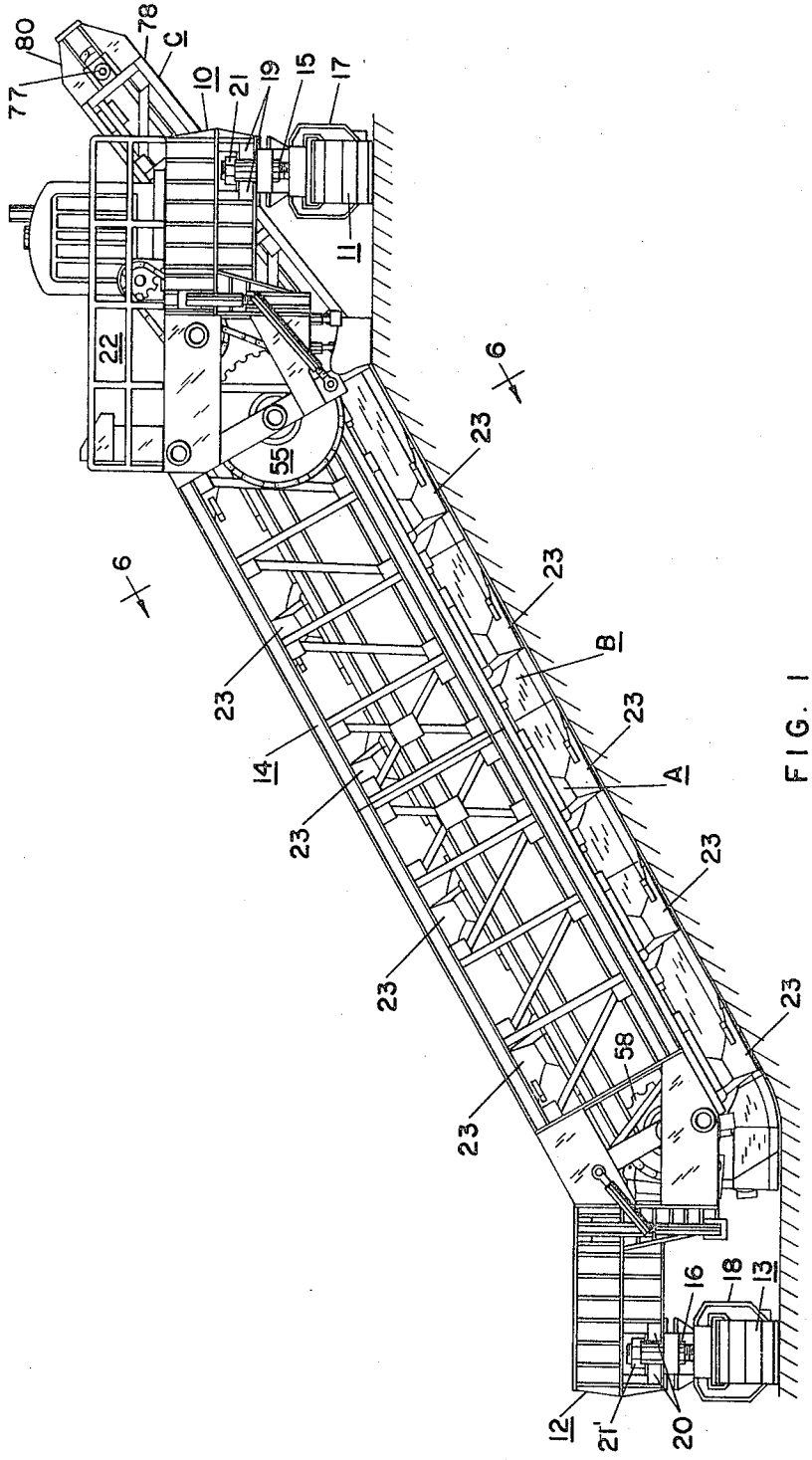

FIG. 1

COMBINATION EXCAVATING AND TRIMMING MACHINE

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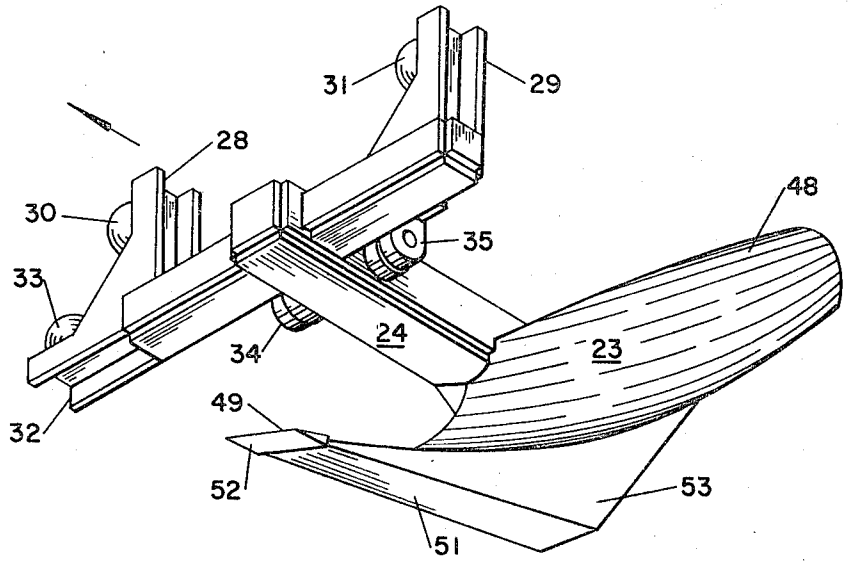

FIG. 2

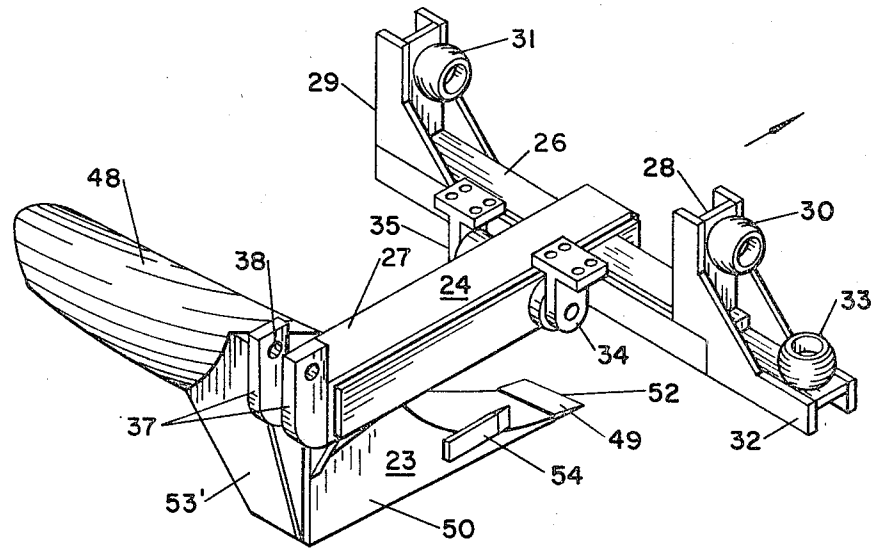

FIG. 3

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COMBINATION EXCAVATING AND TRIMMING MACHINE

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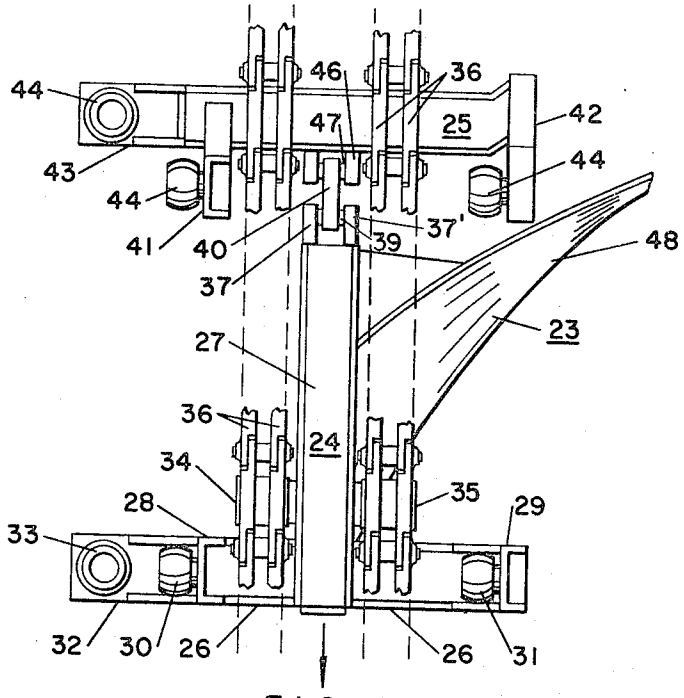

FIG. 4

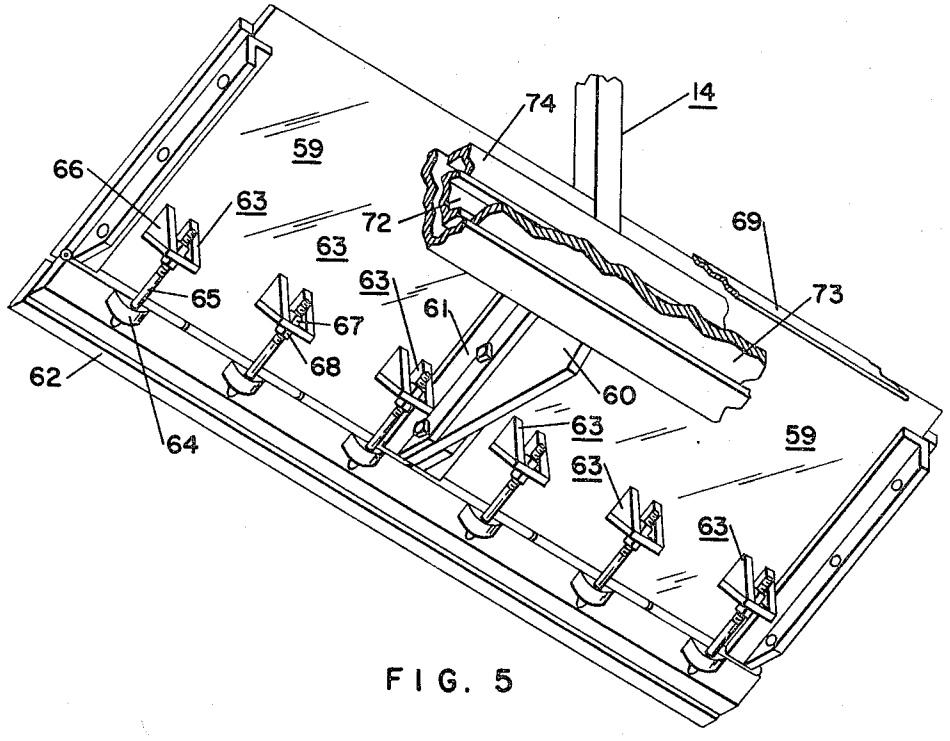

FIG. 5

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COMBINATION EXCAVATING AND TRIMMING MACHINE

Filed Dec. 27, 1965 5 Sheets-Sheet 4

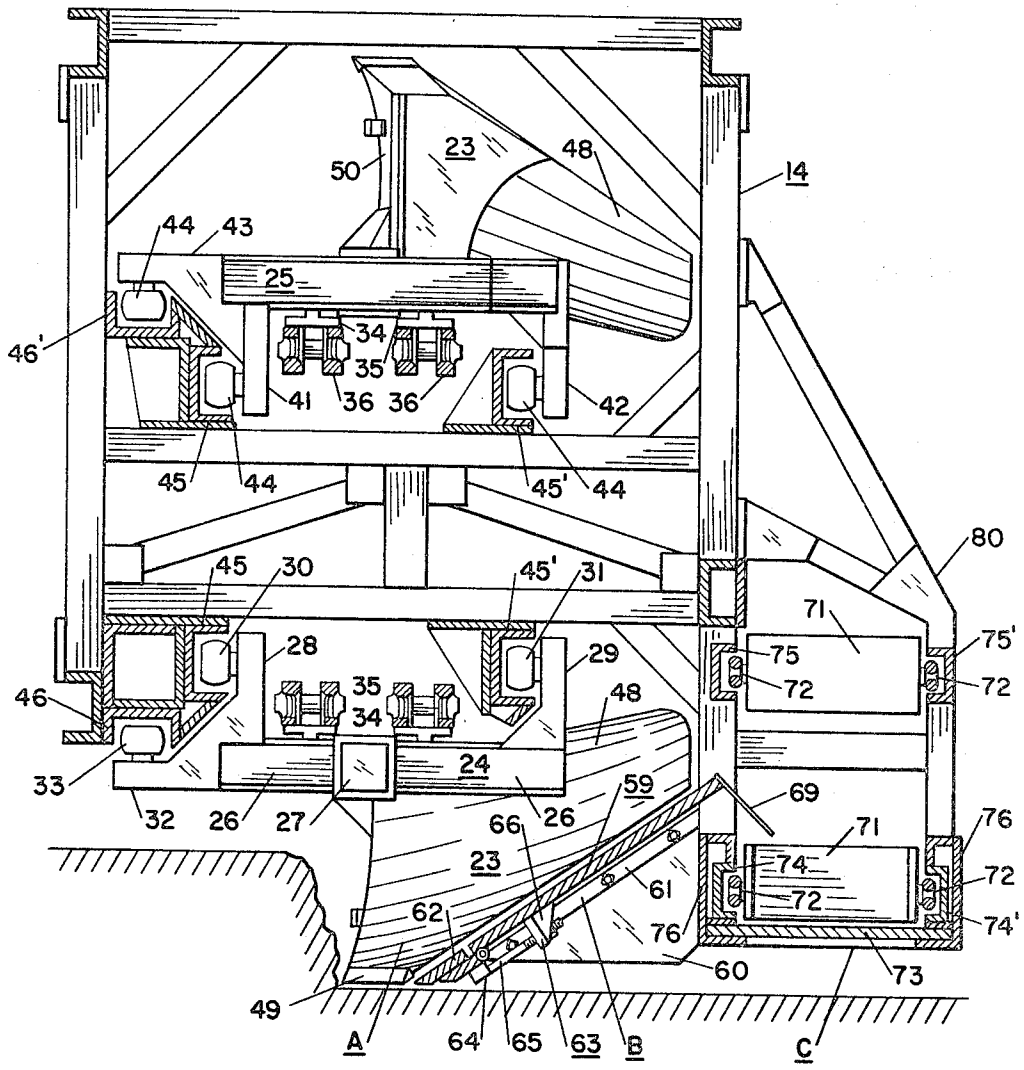

FIG. 6

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COMBINATION EXCAVATING AND TRIMMING MACHINE

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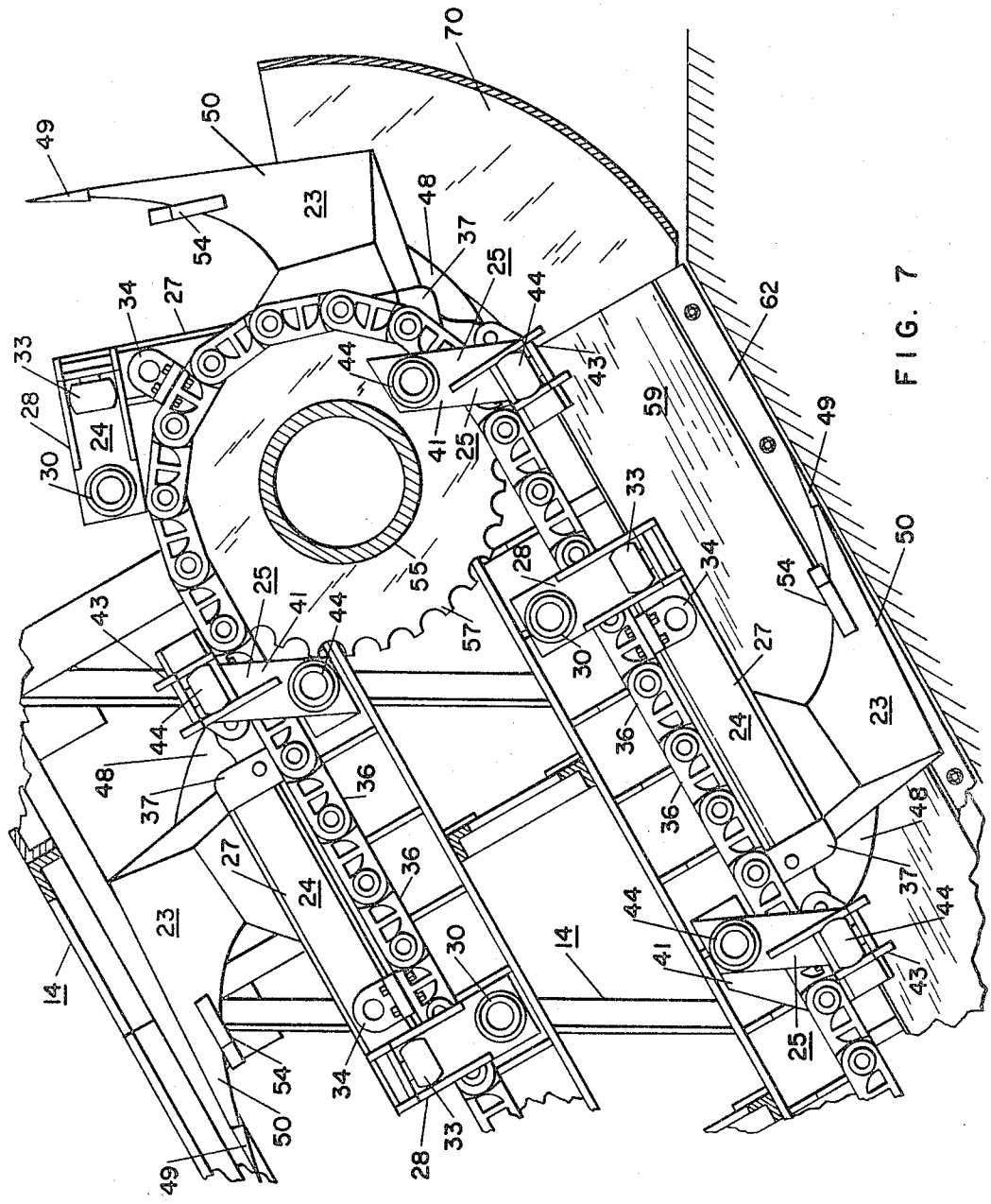

FIG. 7

United States Patent Office 3,310,893
Patented Mar. 28, 1967

3,310,893

COMBINATION EXCAVATING AND TRIMMING MACHINE

Alfred Perry, Moses Lake, and Harry Dewey Durston, Kennewick, Wash., assignors to J. A. Terteling & Sons, Inc., Boise, Idaho

Filed Dec. 27, 1965, Ser. No. 516,402
11 Claims. (Cl. 37—85)

The present invention relates to an earth excavating and trimming machine used in the construction of earth foundations for roads, canals, and the like, and, more particularly, to the combination of earth engaging apparatus and implements, and earth handling apparatus associated therewith.

In the construction of water conduits, it is common practice to excavate the conduit by conventional earth moving equipment to roughly a trapezoidal cross-sectioned configuration. In some instances, particularly in shot or blasted portions, the walls of the conduit are over excavated and later provided with a compacted surfacing aggregate blanket comprising earth materials of various specified graded particle sizes. The surfacing blanket is then trimmed to accurate dimensions in order that a suitable foundation is formed thereby. Where the conduit is constructed in earth material having substantially uniform and stable characteristics that have been determined to be suitable, the indigenous earth material is trimmed to neat line dimensions so that it is free of pockets and lenses. When the foundation of the conduit is thus suitably prepared, an impervious wearing blanket of uniform thickness may be placed over the foundation, if desired, to form the surface structure of the conduit.

It is commonly known in the art that the apparatus and implements used to work the several kinds of earth materials such as rock, gravel, sand, clay, and the like, must generally conform to a structure and a configuration peculiar to the material mass to be handled. All or most of the several kinds of earth materials are usually encountered in various portions of the meandering course of the conduit. Therefore, trimming machines formerly known in the art were specially designed to suit the most common materials in a particular conduit, and, while the functions of such machines are similar, they necessarily differ substantially in structure.

At one time, it was practical to over-excavate large portions of the conduit containing materials which could not be handled by given implements or apparatus on the machine, and to backfill and compact into such portions borrow material which could be trimmed. The present state of the economy is such that it is not feasible to fit the materials of a conduit to a particular apparatus.

It is an object of the present invention to provide in excavating trimming machines, apparatus and implements which may be adapted to a trim a plurality of types and kinds of earth material, and to provide means for trimming non-uniform materials.

Other objects of this invention are to provide an improved excavating-trimming apparatus for accurately and economically trimming the several walls of a conduit to neat line dimensions free of pockets and lenses; to provide an apparatus of stable construction which obviates the tendency inherent in excavating-trimming machines, to contort, and thereby mis-align the conduit; to provide in an excavating-trimming machine the combination of an excavating means and a trimming means whereby excavated and trimmed earth material is contained and conducted by said means away from the foundation of the conduit; and to provide in an excavating-trimming machine the combination of an excavating means, a trimming means, and a material discharge means whereby excavated and trimmed earth material is contained and conducted by said excavating means and said trimming means into the said discharge means and thereby carried away from the conduit, said operations being concurrently and continuously performed in a single pass of the machine as it is moved longitudinally over the course of the conduit.

The present invention is herein disclosed and described in the environment of a single slope excavating-trimming machine, notwithstanding the fact that the invention can be used with apparatus operable on horizontal surfaces such as canal invert portions, roads, airfields, and the like, and may be used with excavating-trimming machines which conform to the cross section configuration of a water conduit.

A typical single slope excavating-trimming machine known in the art which may be adapted to use and employ the elements and structure of the apparatus and implements disclosed by the present invention is the Canal Wall Trimmer, United States Letters Patent 2,867,046 issued to Josef Baer on Jan. 6, 1959, and owned by the assignee of the invention herein disclosed. Such machines are characterized by a work frame carrying excavating and trimming apparatus and implements which are disposed between an upper transport vehicle intended to travel along the berm or upper terminus of the finished conduit, and a lower transport vehicle which travels on the bottom or invert portion of the conduit. The transport vehicles may variously comprise wheel, rail, or crawler type units, which may be independently or synchronously driven if desired. To suitably perform the work intended, the work frame carried by the vehicles is usually mounted so that it may be raised and lowered at the front, rear, top, bottom, or at all or any portion of the frame in order that the frame may be independently juxtapositioned to the work face regardless of the attitude or position of the transport vehicles, or either of them.

The present invention comprises in an excavating-trimming machine the combination of a novel side discharge excavating bucket which thereby discharges excavated earth material rearwardly to the direction of travel of the machine, a sloping trimming blade forming substantially a continuously fixed side for the bucket as the bucket travels transversely over it, and a discharge drag conveyor arranged so that excavated and trimmed earth material is conducted into it by the buckets and the trimming blade.

A plurality of buckets is drawn transversely to the direction of travel of the machine, or lengthwise about the work frame, by a pair of endless chains suitably fastened to each of the buckets. The chains travel over respective pairs of sprockets secured to each of two drums journalled for rotation at the terminal ends of the work frame. Guide channels are provided on the work frame in which guide rollers, journalled in each of the bucket carrier members, travel. Consequently, the buckets are carried in alignment with the work frame, as well as being contiguously aligned with the angularly disposed trimming blade depending from the under portion of the work frame and disposed along the length of the work frame.

The configuration of each of the buckets of the present invention approximates that of one-half of a plow having a rearwardly disposed mouldboard, the bottom of which is upwardly sloping. The mouldboard portion of the buckets is carried in a sweeping-like manner over the trimming blade of this invention. The trimming blade is carried by the work frame at an upward and rearward sloping angle which is nearly the same angle as that of the bottom portion of the mouldboard of the buckets. Thus, the mouldboard portion of the buckets forms a material containing member with the trimming blade. Further, the curvilinear configuration of the faces of the

buckets, the rearward angle at which the buckets are disposed to the trimming blade, and the angle of the trimming blade together tend to cause the excavated material to be conducted up and over the trimming blade as the buckets sweep over the blade.

That portion of the buckets which may be compared to the share of a plow, is provided with an earth cutting portion which may include ripper teeth, scarifier teeth, bucket teeth, a bucket cutting edge bit, a mouldboard bit, or the like which are suitable for excavating the particular type of earth material encountered. Similarly, the relieved straight landside portion forming the terminal side opposite the landside portion of the present bucket is provided with means for mounting teeth or cutting edge bits which may be required in the several classes of earth material.

The trimming blade of the present invention comprises a flat, rearwardly sloping mouldboard portion depending from the under portion of the work frame, a mouldboard bit adjustably mounted along the earth engaging portion of the mouldboard, and a downwardly sloping discharge apron extending along the upper trailing edge of the mouldboard. The discharge apron of the trimming blade overhangs a discharge drag conveyor carried by the work frame behind the trimming blade and extending beyond the work frame to a point of discharge. A reverse crown shield is provided at the upper terminal end of the trimming blade to contain and discharge material in the bucket in its path about the work frame and over the upper drum.

It should be pointed out that the buckets of the present invention may have either an upwardly or downwardly moving lower flight.

The nature and advantages of the invention will appear manifest from the description following and the accompaying drawings, which, however, are illustrative only of one embodiment of the invention. The invention here disclosed is intended to be limited only by the scope of the appended claims.

FIGURE 1 is a front elevational view of an excavating-trimming machine approaching the work face to be excavated and trimmed carrying earth engaging apparatus and implements of the present invention.

FIGURE 2 is an isometric projection of the excavating means of this invention as viewed from the bottom earth engaging position and the discharge side in an upwardly moving excavating flight of said means.

FIGURE 3 is an isometric projection of the excavating means of FIGURE 2 as viewed from the top portion and the excavating earth engaging side of said means.

FIGURE 4 is a plan view of the excavating means.

FIGURE 5 is a rear view of the trimming means of this invention as viewed from the aft underportion thereof.

FIGURE 6 is a cross sectional view of the apparatus here disclosed taken along line 6—6 of FIGURE 1.

FIGURE 7 is a fragmentary substantially cross sectional side elevational view of an excavating-trimming machine carrying earth engaging apparatus and implements of the present invention with a portion of the work frame removed.

Referring now to the drawings and more particularly to FIGURE 1, the invention is shown in the environment of a crawler mounted, single slope, canal wall excavating-trimming machine having an upper slope transition structure **10**, carried by an upper transport crawler vehicle **11**, a lower slope transition structure **12**, carried by a lower transport crawler vehicle **13**, and a work frame **14** disposed therebetween. Transport vehicles commonly known in the art, such as vehicles **11** and **13**, are usually provided with a front and a rear raising and lowering means, which preferably may be both independently and sychronously operated. In FIGURE 1, front jack screws **15** and **16**, shown on respective vehicles **11** and **13**, are typical of such raising and lowering means. Front jack screws **15** and **16**, and rear jack screws (not shown) are suitably fastened to respective vehicle mounting frames,

such as to front yokes **17** and **18**, and to rear yokes (not shown), which, as here disclosed, are connected to the respective crawler beams of the vehicles to form the vehicle mounting frames. A forked bolster may be disposed between each of the respective front and rear raising and lowering means, and may be axially mounted so that the bolster may move in response to either or both of the respective front and rear raising or lowering means. One of the forked ends of each of the bolsters **19** and **20** is shown on both sides of the front raising and lowering means **15** and **16** of the respective vehicles.

Upper slope transition structure **10** and lower slope transition structure **12** may be carried on king pins, such as shown at **21** and **21'** about which the respective structures **10** and **12** may be articulated. King pins **21** and **21'** are centrally mounted on respective bolsters **19** and **20**. It may be desirable to provide transition structures supporting turning quadrants on each of the respective bolsters, so that the weight of each of the upper and lower transition structures **10** and **12**, and consequently the work frame and its appurtenances disposed therebetween may be more evenly distributed over the respective bolster and its supporting vehicle. If such quadrants are employed, rollers may be provided on the respective structures **10** and **12** to ride in each of the respective turning quadrants.

A motive power and control center, such as indicated generally at **22** may be located on either of the transition structures **10** and **12**. Power may be supplied by any of a variety of power sources, such as by a diesel electric generating set commonly known in the art, and may, in addition, include hydraulic units necessary to operate, either conjunctively or alternatively the operating devices and apparatus forming a part of the present structure.

Work frame **14** comprises a bridge-like truss, suitably fastened at its upper terminal end to upper slope transition structure **10**, and at its lower terminal end to lower slope transition structure **12**. Work frame **14** may be juxtapositioned to a given earth foundation or work face independently of the respective carrying transport vehicles by operation of the several raising and lowering means. Thus, the relationship of the work frame **14** and the apparatus, and implements carried by it, with the earth foundation may be varied as the work frame is moved longitudinally over it. The depth of excavation, the angle of attack of apparatus and implements on the machine, the transverse angle at which the machine shall work on the conduit walls, and the twisting of the work frame to compensate for impact forces inherent in excavating non-uniform materials between the upper and lower portions of the conduit may be also independently controlled. Common to such apparatus today are automatic line, slope and grade controls which are actuated in response to signals, electrically, hydraulically or mechanically generated from a datum reference. Hence, once established manually, excavating trimming machines may be assumed to operate at a constant predetermined position.

The principal teachings of the invention here disclosed concern the combination of a novel side and thus a rearwardly discharge excavating means, a trimming means in operative engagement with the excavating means to thereby form a material conducting and discharging means, and the further combination therewith of a conveyor means for removing excavated and trimmed earth material from the conduit. To avoid descriptive redundancy, the excavating means assembly, the trimming means assembly, and the conveyor means assembly, generally indicated in the drawings by the indicia A, B, and C respectively, shall be first severally described as to their respective structure and independent operation. Excavating means assembly A, shown to advantage in FIGURES 2, 3, and 4 comprises a bucket portion **23**, a carrier frame portion **24**, and a frame guide portion **25**. The carrier frame portion **24** is substantially a T-shaped tow bar wherein the transverse portion or limbs are identified by the numeral

26, and the perpendicular portion or trunk is identified by the numeral 27. A pair of upwardly projecting hanger members 28 and 29 are provided at the terminal ends of limbs 26. A guide roller 30 and a guide roller 31 are journalled in each of the respective hanger members 28 and 29. Hanger member 28 is also provided with an outwardly projecting member 32 in which is journalled an upwardly facing thrust roller 33 similar to rollers 30 and 31. A pair of carrier chain mounting blocks 34 and 35 are rotatably mounted on both sides of trunk 27 immediately aft of each of the limbs 26. Holes are provided in blocks 34 and 35 through which bolts may be extended to suitably fasten links 36 of an endless chain hereinafter later described. At the aft end of trunk 27 are a pair of upwardly projecting clevis-like coupling members 37. Each of the clevis-like members 37 is provided with a hole 38 through which a pin 39 may be inserted to carry a coupling link 40 disposed between carrier frame portion 24 and frame guide portion 25. Frame guide portion 25 is similar in structure to limbs 26 of carrier frame portion 24.

In frame guide portion 25, projections 41, 42, and 43 are provided and are similar to respective projections 28, 29, and 32 on carrier portion 24. Each of the projections 41, 42, and 43 is provided with a roller 44. FIGURE 6 shows to advantage guide channels 45 and 45' and thrust channels 46 and 46' which are provided on work frame 14. Respective guide rollers 30, 31 and 44, and thrust rollers 33 and 44 are caused to ride in the frame channel members as the excavating means A is drawn about work frame 14. Referring again to FIGURE 4, it will be noted that links 36 of endless chains are suitably fastened to the body of frame guide portion 25. Between the chains is a clevis-like coupling 46 on carrier frame portion 25 similar to clevis-like coupling 37. Coupling link 40 may be connected by a pin 47 extending through coupling link 40 and clevis-like couplings 46. By this means the excavating assembly A may be articulated about head and tail pulleys or drums on the work frame 14, as the excavating means assembly A is drawn about work frame 14.

Bucket portion 23 is substantially plow shaped, and comprises a mouldboard portion 48, a share portion 49, a landslide portion 50, and a sole plate portion 51. Mouldboard portion 48 is rearwardly disposed from the direction of travel of the bucket which is transverse to the work face. The bottom engaging portion of mouldboard 48 is upwardly sloping. The face of mouldboard 48 is a concave, curvilinear configuration which is provided with upward convolutions in a pattern geometrically similar to the sloping bottom engaging portion of mouldboard 48. The share portion 49 may be provided with any of a variety of earth engaging tools such as ripper teeth, scarifier teeth, bucket teeth or a bucket cutting edge bit, which are consistent with the type earth material to be excavated. A replaceable bucket edge bit is represented at 52 in FIGURES 2 and 3. Sole plate portion 51 extends substantially over the bottom of the bucket portion 23 from the earth engaging tool portions such as 52 to the bucket body reinforcing members 53, 53' and the landside 50. Sole plate 51 is substantially a flat plate having a rectangular configuration. The sole plate 51 overcomes the inherent tendency of the bit 52 to dig deeper into the earth foundation by reason of its angle of attack to the foundation. It should be pointed out, however, that bucket portion 23 is carried at a downward and laterally tilted angle so that the leading earth engaging tip of bit 52 first impinges the work face.

Landside portion 50, together with bucket body sides 53 and 53' and sole plate 50, forms a rigid reinforced bucket body portion for the mouldboard 48. FIGURES 2 and 3 show to advantage the rearward angle at which the landside portion 50 is disposed so that the landside 50 is relieved from the side thrust which would otherwise exist by reason of the excavating means assembly A being crowded or forced against the unexcavated work face as the trimming machine is moved longitudinally of the conduit. The landside 50 may be provided with any of a variety of earth engaging tools. A ripper tooth 54 shown in FIGURE 3 is illustrative of such a tool commonly known in the art.

A plurality of excavating means assemblies A are moved in the respective guide channels 45 and 45' and thrust channels 46 and 46' transversely about the work frame 14 by a pair of endless chains made up of links 36. A drum 55 and a drum 56 are journalled for rotation at the upper end and the lower end of the work frame 14, respectively. A pair of sprockets 57 and 57' and sprockets 58 and 58' are mounted on each of the respective drums 55 and 56. A drive assembly, such as a chain and sprocket may be connected to either or both of the drums 55 and 56 and to a suitable motive power means to drive the drums and the sprockets carried thereby. The links 36 may be similar to those commonly known in the art, and frequently used on endless track laying vehicles such as bulldozers and the like. Such links are characterized by having pins disposed between a pair of link bodies which are intended to be carried by sprockets. Each of the link bodies is bolted or suitably fastened to grousers or, in the present invention, to the frame carrier portion 24 and the frame guide portion 25 of excavating means assemblies A.

Trimming means B comprises a blade portion 59 which is carried by a plurality of brackets 60 depending from the work frame 14. Blade portions 59 are fabricated in a plurality of sections, two of such sections are shown to advantage in FIGURE 5 as they appear from the under portion of blade 59. Angle members 61 are welded or suitably fastened near each of the terminal ends on the underside of the sections of blade portion 59 so that the sections may be suitably fastened together in end to end relationship. Angle members 61 thus provide a bolting flange. It will be observed that members 61 are disposed approximately the distance of one-half the thickness of brackets 60 from the terminal ends of the respective sections of blade portion 59, and that bolts are provided which extend through the respective angle members 61 and through the brackets 60 to fasten the blade portions together and to brackets 60. Hence, the engaging faces of the sections of blade portions 59 form a continuous blade portion along the length of work frame 14. FIGURE 6 shows to advantage the cross section configuration of blade portion 59. Blade portion 59 is provided with a hinged portion along the earth engaging portion of the blade 59 to receive an earth cutting tool such as mouldboard bit 62, and to provide means for adjusting the angle of attack of the bit. Bit 62 may be any of a variety of earth engaging tools of the bolt-on type commonly known in the art. The hinged portion of blade portion 59 is provided with a plurality of vertically elongated slots (not shown) for adjusting bit 62 upwardly and downwardly.

A plurality of bit adjusting means, generally designated 63, is provided on the under portion of the sections of blade portion 59. Bit adjusting means 63 comprises a block portion 64 having a threaded hole to receive a mounting bolt extending through bit 62, blade portion 59 and into block portion 64, a holding rod portion 65, welded or suitably fastened to block portion 64, and a bracket 66 suitably fastened to blade portion 59. Rod portion 65 is extended through bracket 66 and is threaded at its upper end. A pair of nuts 67 and 68 are provided on rod 65 on either side of bracket 66 to firmly hold the rod 65. Should rock or a boulder be encountered in the earth foundation material being trimmed, the bit adjusting means 65 would prevent the bit 62 from being forced upwardly by reason of the impingement of the bit 62 with such rock or boulder. Further, fore-shortening or extending the rod 65 by means of adjusting nuts

67 and 68, the hinged portion, and consequently the bit 62 is caused to change its angle of attack.

A downwardly sloping discharge apron 69 is provided along the upper trailing edge of blade portion 59. The apron 69 may be fabricated in sections which may be suitably fastened to the several sections of blade portion 59.

It may be observed that blade portion 59 is flat and rearwardly sloping at an angle nearly the same as the upward sloping configuration of mouldboard 48 of bucket portion 23.

The bucket portion 23 being carried about the work frame 14 transversely to the blade portion 59, may be mounted ahead of blade portion 59 to windrow the excavated earth material in front of blade portion 59 to be later picked up by blade portion 59 and forced over apron 69 as the machine is advanced, or the bucket portions 23 may be mounted so that the mouldboard 48 of bucket portions 23 are contiguous with blade portion 59 as shown in the drawings. In either event, the earth material is pushed forwardly by reason of the convoluted, concave, curvilinear configuration of the mouldboard 48 of the bucket portions 23. However, the upward convolutions of the bucket portion 23, conforming geometrically with upward sloping bottom engaging portion of the mouldboard 48 of bucket portion 23, and, coincidentally, the blade portion 59, tends to cause the excavated earth material contained between the bucket portion 23 and the blade portion 59 to be moved upwardly over blade portion 59. Further mechanical advantage is gained to lift the earth material by reason that the mouldboard 48 of the bucket portion 23 is disposed rearwardly, thus causing the earth material to be swept tangentially up over the blade portion 59 as the bucket portions 23 are carried in their flight over blade portion 59. Hence, the earth material is caused to be discharged over apron 69 of blade portion 59.

Because the bucket portions 23 and the blade portion 59 do contain a quantity of material at any given point along the flight of bucket portions 23, it is necessary to provide means for discharging material thus contained at the end of the excavating flight of bucket portions 23 and at the terminal end of the blade portion 59. For this purpose, a reverse crown shield, conforming to the earth engaging edge configuration of the mouldboard 48 of bucket portion 23, and which further conforms to the arcuate path of the flight of the bucket portion 23 over the respective drums, such as 55 or 56, is provided at the terminal end of blade portion 59 coinciding with the end of the excavating flight of the bucket portion 23. It should perhaps again be pointed out that the teachings of this invention include either an upwardly moving lower excavating flight or a downwardly moving lower excavating flight of the bucket portion 23 over blade portion 59. Hence, a crown shield can be located at either of the terminal ends of blade portion 59, depending upon the direction of the excavating flight of bucket portions 23. For illustration only, the present invention is disclosed in the environment having upwardly moving bucket portions 23. Hence, the reverse crown shield as shown in the drawings is mounted on the under portion of work frame 14 at the upper terminal end of blade portion 59. FIGURE 7 shows to advantage the reverse crown shield which is generally designated by the numeral 70. Remembering that the engaging bottom edge of mouldboard 48 of the bucket portions 23 is continguous with the face of reverse crown shield 70 as the bucket portions 23 are carried over the crum 55, and further recalling that the mouldboard 48 is rearwardly disposed, the earth material contained by the bucket portion 23 and the reverse crown shield 70 can be discharged downwardly over the aft terminal end of mouldboard 48. This is true because as the bucket portion 23 is carried up over the respective drum, the rearwardly disposed mouldboard 48 assumed a downward position.

In practice it has been learned that the scouring characteristics of the mouldboard portion 48 of bucket portions 23 is a very important element to the successful operation of the present invention. However, efficient scouring is directly related to the particular characteristics of each of the several earth materials encountered to be excavated. Hence, just as the earth engaging portions of the excavating means A is provided with means for attaching any of a variety of earth engaging tools known in the art which may be adopted to excavate the particular earth materials, the mouldboard portion 48 may be provided with or comprise chain rappers commonly used in clay materials, a rock skeleton, a blade as shown for illustration of this invention, or the like commonly known in the art. The principal teachings here disclosed relate specifically to the silhoutte configuration which may be adapted to the particular structure necessary in specific earth materials.

Conveyor means assembly C is not unlike drag or flight conveyors commonly known in the art which are characterized by a plurality of vertical flat members being carried by an endless chain over a pan or plate portion to push material in its path ahead of it to a point of discharge. The most notable advantage of such means is that they may be operated at much steeper angles and at higher speeds than other conveyor means known in the art. In the present invention, conveyor means C comprises a plurality of U-shaped buckets 71 carried by an endless chain 72, the lower flight of which buckets 71 are contiguous with a bottom plate 73, shown to advantage in FIGURE 6. The endless chain is carried in respective pairs of channel members 74, 74', and 75, 75' in order to protect the chain 72 from direct abrasion of the earth material falling into the conveyor. The channel members 74 and 74' together with conveyor body portions 76 and plate 73, form an open box about the conveyor buckets 71. Hence, material discharged into the conveyor means C may be contained to the point of discharge.

Referring now to FIGURE 1, it may be observed that buckets 71 are carried over a head pulley identified by the numeral 77. At a point near the terminal end of the conveyor means frame which is designated 78, the plate 73 is terminated. In the drawings, conveyor means frame is distinguished from the work frame 14 by the numeral 80, although, in practice, the frame 80 may be merely an extension of work frame 14 of the apparatus. As the buckets 71 push the earth material ahead of them at the terminal end of plate 73, the material is caused to fall over the end and thereby be discharged at point 78. It may be to advantage to discharge earth material in the invert or opposite side of conduit. In such an event, the material discharge portion may be located at opposite lower end of the work frame 14.

In operation, material is continuously conducted over the apron 69 of trimming means B and into conveyor means C as the excavating means A sweeps over the trimming means B in its excavating flight. In this manner, the excavating means assembly A is not limited by its material carrying capacity. It is well known in the art that when an excavating means is filled to capacity, such means acts as a bulldozer pushing earth material ahead, with the result that further excavating or digging is limited. On the other hand, an endless conveyor may carry a substantially greater volume of earth with far less horse power being required. Further, the present invention provides means whereby the material is kept "alive" or not permitted to come to rest, by which substantial savings may be realized in mechanical effort required. The feature of the buckets continually discharging rearwardly to the direction of travel of the machine and onto the conveyor thereby permits optimum utilization of excavating apparatus and implements on the buckets.

Conventional means may be suitably located on the machine of the present invention to effect operation of the various assemblies herein shown and described. Although we have herein shown and described preferred combinations and sub-combinations of this invention, it is, of course, to be understood that various changes may be made herein. More particularly, as indicated earlier in this specification, the entire machine described hereinabove is of great utility in the excavating-trimming operations for road foundations, runway foundations and the like, and on machines conforming to the full cross sectioned configuration of a water conduit, as well as in a single slope operation. Moreover, the more advantageous features of the invention, forming sub-assemblies of the complete machine, are usable apart from each other. Accordingly, the invention is not to be considered limited to the structure and uses particularly described herein but rather, only by the scope of the appended claims.

We claim:

1. In a combination excavating and trimming machine including a work frame disposed between respective transport vehicles, the combination of an excavating means carried by the work frame and including a plurality of digging members, each of said digging members having integral therewith earth cutting implements in substantially continuous engagement with an earth foundation, when said digging members are progressively excavating material therefrom;

a drive means operatively connected to said excavating means for moving said earth cutting implements of each of said digging members progressively into engagement with earth material; and

a trimming means depending aft of the excavating means for scraping excavated earth material from the earth foundation, said trimming means being disposed transversely to the direction of travel of the machine and being substantially coextensive in length with the work frame; and

wherein each of said digging members has an integral engaging portion thereof positioned in vertical overlapping relationship and being substantially contiguously to a portion of the said trimming means; and

said trimming means cross section configuration substantially conforming to the geometric silhouette of said vertically overlapping integral engaging portion of each said digging members; and

said overlapping integral engaging portion of each said digging members and said overlapped portion of the trimming means define therebetween a means for containing excavated and trimmed earth material and a means for conducting the materials so contained rearwardly to the direction of travel of the machine and over the trimming means toward a point of disposal of said materials, whereby the excavated and trimmed earth materials are subjected to movement substantially continuously by said containing and said conducting means.

2. The combination excavating and trimming machine of claim 1, including a discharge conveyor means on the machine operable to carry away the excavated and trimmed earth materials to the point of disposal from the machine, and wherein the excavating and trimming means are operable as the machine is advanced along a work path to conduct the excavated and trimmed earth materials contained therebetween onto said discharge conveyor means, whereby said materials are thereafter carried by the discharge conveyor means to the point of disposal from the machine.

3. In a combination excavating and trimming machine including a work frame disposed between respective transport vehicles, the combination of an excavating means carried by the work frame for excavating earth material from an earth foundation; a drive means operatively connected to said excavating means for driving the excavating means into substantially continuous engagement with an earth foundation; and a trimming means depending from the machine aft of the excavating means for trimming earth material from an earth foundation, said trimming means being disposed transversely to the direction of travel of the machine and being substantially coextensive in length with the work frame; and wherein said excavating means includes a mouldboard portion positioned in vertical overlapping relationship to a portion of the trimming means, the lower edge of said mouldboard portion being substantially contiguous with the upper surface of said overlapped portion of the trimming means; and said mouldboard portion and said trimming means define therebetween a means for containing excavated and trimmed earth materials and a means for conducting the materials so contained rearwardly to the direction of travel of the machine and over the trimming means toward a point of disposal of said materials from the machine, whereby the excavated and trimmed earth materials are subjected to movement continuously by said containing and said conducting means.

4. The combination excavating and trimming machine of claim 3, including a discharge conveyor means on the machine operable to carry away the excavated and trimmed earth materials to the point of disposal from the machine, and wherein the excavating and trimming means are operable as the machine is advanced along a work path to conduct the excavated and trimmed earth materials contained therebetween onto said conveyor means, whereby said materials are thereafter carried by the discharge conveyor means to the point of disposal from the machine.

5. The combination excavating and trimming machine of claim 3, including a discharge conveyor means carried by the machine adjacent and aft of said trimming means, said discharge conveyor means extending transversely to the direction of travel of the machine to the point of disposal of the excavated and trimmed earth materials therefrom, and wherein the excavating and trimming means are operable as the machine is advanced along a work path to conduct the excavated and trimmed earth materials contained therebetween onto said discharge conveyor means, whereby said materials are thereafter carried by the discharge conveyor means to the point of disposal from the machine.

6. The combination excavating and trimming machine of claim 3 wherein said excavating means comprises a conveyor having a plurality of plow shaped buckets thereon, said conveyor being carried transversely to the direction of travel of the machine by the work frame and extending along the length of the work frame about rotatable supports journalled in each of the ends of the work frame, said plow shaped buckets each including one of said mouldboard portion and being operable to excavate earth material from an earth foundation as the machine is moved along a work path; and wherein said trimming mens comprises a fixed trimming blade depending from the work frame at an angle coextensive with and adjacent to the mouldboard portion of each of said plow shaped buckets, said trimming blade being aft of said plow shaped buckets on the work frame and being substantially co-extensive in length transversely to the direction of travel of the machine with the distance between the terminal ends of the work frame, said trimming blade being operable to trim earth material from an earth foundation as the machine is moved along a work path; and wherein said plow shaped buckets are operable to carry and to conduct the excavated and trimmed earth materials upwardly over said trimming blade in the excavating flight of said buckets.

7. The apparatus of claim 3 in which said excavating means comprises a conveyor having a plurality of plow shaped buckets thereon, said conveyor being carried transverse to the direction of travel of said machine by said work frame and extending along the length of said work

frame about rotatable supports journalled in each of the ends of said work frame, said plow shaped buckets each including one said mouldboard portion and being operable to excavate and to trim excess material from an earth foundation as said machine is moved along its work path; said trimming means comprising a fixed trimming blade depending from said work frame at an angle coextensive with and adjacent to the mouldboard portion of each of said plow shaped buckets, said trimming blade being aft of said plow shaped buckets on said work frame and being coextensive in length transverse to the direction of travel of said machine and at least as long as the distance between the terminal ends of said work frame of said machine, said trimming blade being operable to further trim excess material from said foundation as said machine is moved along its work path; said plow shaped buckets being operable to carry and to conduct excavated and trimmed material upwardly and over said trimming blade in the excavating flight of said plow shaped buckets over said trimming blade; said apparatus including a curvilinear plate shield substantially conforming to the bottom engaging portion of said plow shaped buckets as said buckets are carried about one of said rotatable supports on said frame work, said shield being suitably fastened at one of the ends of said work frame to the terminal end of said trimming blade and to said work frame, said shield being operable to contain material between said plow shaped buckets and said shield as said plow shaped buckets are inverted in passing over one of said rotatable supports, said plow shaped buckets being further operable to discharge material contained between said shield and said buckets over the end of the mouldboard portions of said plow shaped buckets beyond the terminal side of said shield.

8. The apparatus of claim **7**, including a discharge conveyor means carried by the machine aft of said trimming blade and said curvilinear plate shield and being coextensive in length with and adjacent to said trimming blade and said curvilinear plate shield and being further extended transverse to the direction of travel of said machine to a point of disposal of said material, said trimming blade and said plow shaped buckets being further operable to discharge excavated and trimmed material into said discharge conveyor means as said machine is advanced along its work path, said discharge conveyor means being operable to discharge said material at a point remote from said machine.

9. The apparatus of claim **7** in which each of said plow shaped buckets comprises a bucket portion having a rearwardly and upwardly disposed convoluted curvilinear mouldboard portion, an earth engaging downwardly disposed share portion, a vertical rearwardly relieved landside portion on the side opposite said mouldboard portion, and a sole plate portion on the underside of said bucket portion; a carrier frame portion, said bucket portion being carried on said carrier frame portion; a guide frame portion; a link member, means for connecting said link member to said carrier frame portion and said guide frame portion, said carrier frame portion and said guide frame portion being axially operable to be moved about rotatable supports journalled for rotation in each of the terminal ends of said work frame, a pair of endless chains connected to said carrier frame portion and said guide frame portion operable to carry each of said frame portions and the plow shaped bucket carried thereby about said work frame.

10. The apparatus of claim **7** in which each of said plow shaped buckets comprises a bucket portion having a mouldboard portion, said mouldboard portion being rearwardly disposed from the direction of travel of said

buckets, the bottom engaging portion of which is upwardly sloping, the face of said mouldboard portion being curvilinear, and having upward convolutions geometrically similar to the upward sloping bottom engaging portion of said mouldboard portion; a share portion including means for attaching earth engaging tools, said share portion being downwardly disposed toward the direction of travel of said buckets; a landside portion on the side opposite said mouldboard portion, said landside portion comprising a flat, vertical plate, the leading edge of which conforms to the configuration of the face of said mouldboard portion, said landside portion being further disposed at an angle away from the impinging point of an earth engaging tool attached to said mouldboard portion, means on said landside portion for attaching earth engaging tools; a sole plate portion disposed on the under portion of said bucket between said landside portion and said mouldboard portion; a carrier frame portion comprising a substantially T-shaped tow bar having a pair of upwardly projecting hanger members at terminal ends of the outwardly extending members thereof, an outwardly projecting thrust hanger member extending from one of said upwardly projecting hanger members, rollers journalled in each of said hanger members, said rollers operable to ride in channels provided on the work frame of said machine, said carrier frame portion further having a pair of upwardly projecting clevis-like members at the aft end of said carrier frame portion; a guide frame portion comprising a bar having a pair of upwardly projecting hanger members at the terminal ends thereof, an outwardly projecting thrust hanger member extending from one of said upwardly projecting hanger members and being on the same side as said thrust hanger member on said carrier frame portion, rollers journalled in each of said hanger members, said guide frame portion further having a pair of upwardly projecting clevis-like members disposed at the center thereof on the side adjacent said carrier frame portion; a link member disposed between said clevis-like members on said carrier frame portion and said clevis-like members on said guide frame portion; means for connecting said link members to each of the respective said clevis-like members; and a pair of endless chains connected to said carrier frame portion and said guide frame portion, said chains being operable to carry said plow shaped buckets about said work frame.

11. The apparatus of claim **7**, including a bucket shaped portion on said plow shaped buckets having a leading edge the earth impinging portion of which is downwardly and forwardly disposed with respect to the transverse forward movement of said work frame, a mouldboard curving away from said leading edge in an upward and rearward direction opposite said leading edge, said bucket shaped portion being generally of half plow configuration, and in which the said trimming blade conforms generally to the shape of said bucket shaped portion so as to constitute a continuation thereof and defining generally a closure for said bucket shaped portion.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,310,893 March 28, 1967

Alfred Perry et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 10, line 57, for "mens" read -- means --; column 11, line 24, for "frame work" read -- work frame --.

Signed and sealed this 7th day of November 1967.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents