May 19, 1970 F. J. HAYNES ETAL 3,512,284

BACK HOE TOOTH STRUCTURE

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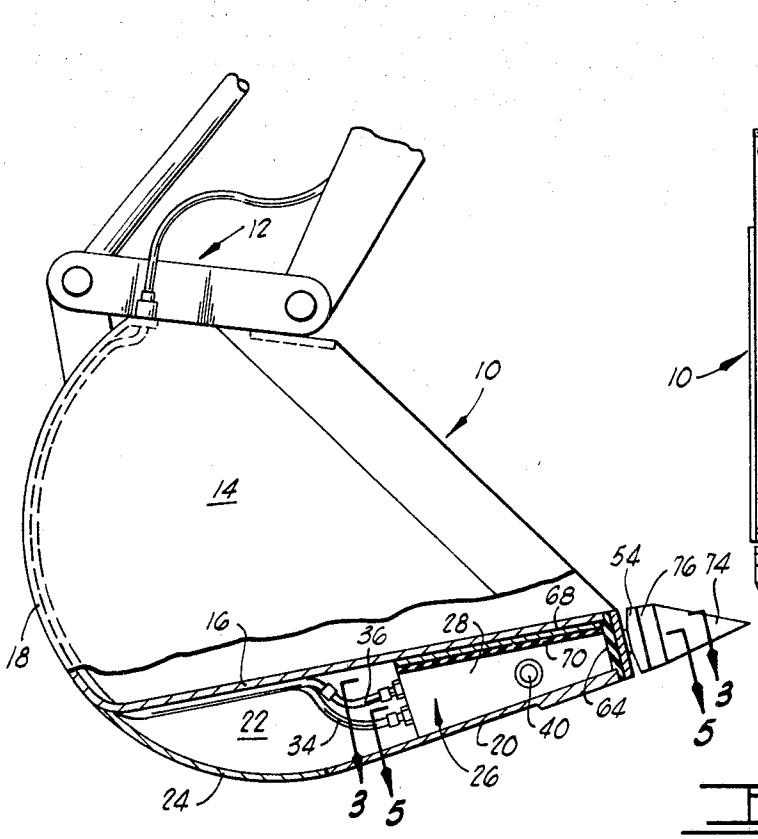


Fig. 2

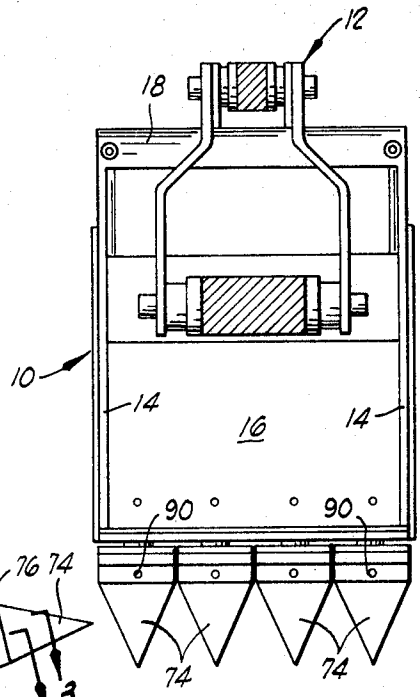


Fig. 1

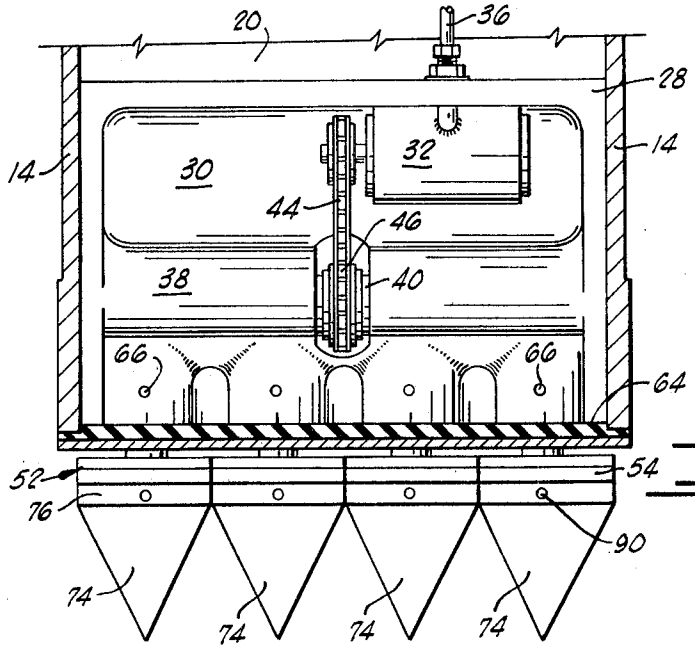


Fig. 3

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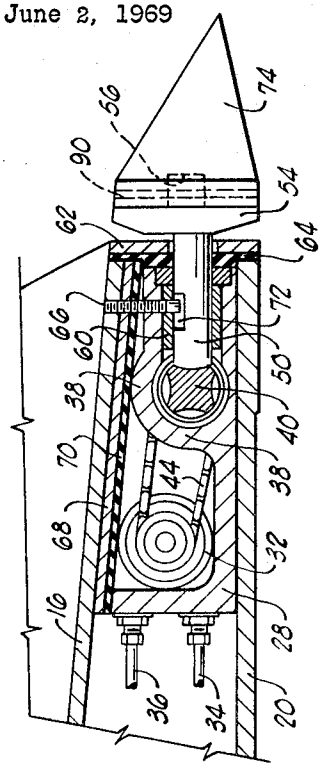


FIG. 4

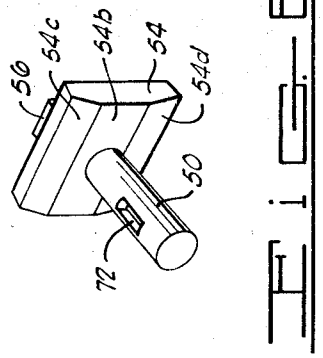


FIG. 8

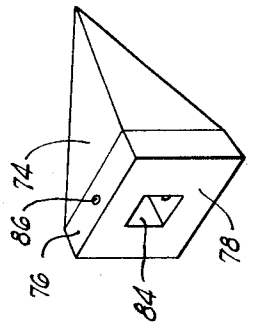


FIG. 7

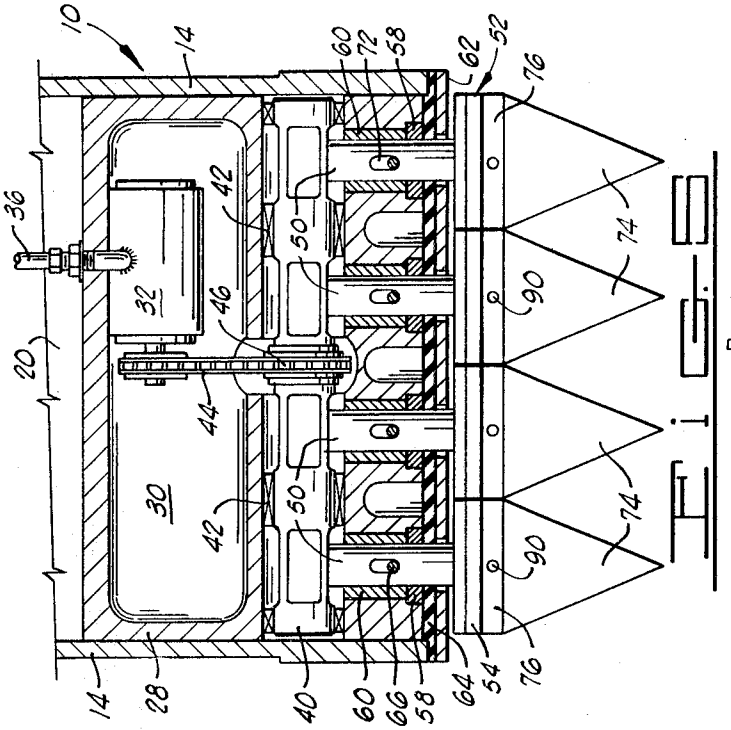


FIG. 5

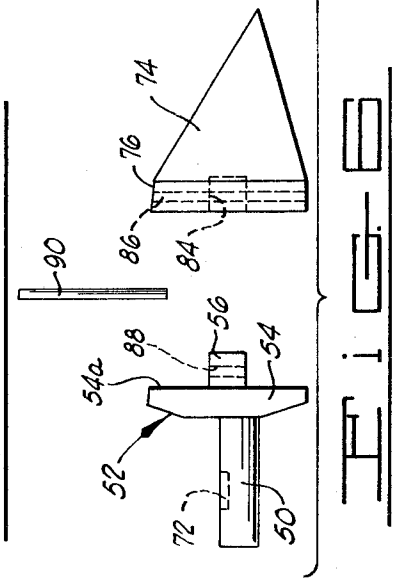


FIG. 6

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BACK HOE TOOTH STRUCTURE

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Continuation-in-part of application Ser. No. 722,990, Apr. 22, 1968. This application June 2, 1969, Ser. No. 829,223

Int. Cl. E02f 9/28

U.S. Cl. 37—141 12 Claims

ABSTRACT OF THE DISCLOSURE

A tooth structure for use in a back hoe of the type having power driven reciprocating teeth, the tooth structure including a pyramidally shaped point formed integrally with a rectangularly cross-sectioned base portion, and a drive rod member detachably secured to the base portion. The drive rod member includes a head portion having a protuberant connector stud which registers with a complementary socket in the base portion of the tooth structure in which the stud is detachably retained. An elongated rod is secured to the head portion of the drive rod member. The head portion of the drive rod member is rectangularly cross-sectioned, and at its point of connection to the drive rod, is characterized in having a dirt displacement face which extends at an angle to a plane extending normal to the longitudinal axis of the elongated rod.

In a different aspect of the invention, a plurality of the described tooth structures are reciprocably mounted on a dirt receiving bucket in juxtaposition to each other. The bucket has a digging leading edge which carries a face plate, and the elongated rods of the drive rod members are mounted for reciprocation through the face plate so that the longitudinal axis of each rod extends substantially normal to the major plane of the face plate.

RELATED APPLICATIONS

This application is a continuation-in-part of Freddie J. Haynes U.S. patent application Ser. No. 722,990 entitled "Back Hoe Apparatus" filed Apr. 22, 1968, now Patent No. 3,448,535.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to earth moving equipment, and more particularly, to back hoe structures having a plurality of movable teeth mounted at the digging edge thereof.

Brief description of the prior art

Back hoes having powered teeth have been heretofore proposed and manufactured. Where the teeth of the back hoe are driven in reciprocation in relation to a leading, digging edge of the bucket of the hoe, a problem exists of preventing dirt impaction between the teeth, or between the teeth and the bucket to the extent that the excavating efficiency of the bucket is impaired. It is also desirable that the teeth on such back hoes be of mechanically strong construction, and it is preferred that such teeth be replaceable quickly by new teeth if they should become damaged.

A back hoe having powered, reciprocating teeth is described in my co-pending application Ser. No. 722,990 of which this application is a continuation-in-part. The present invention is an improvement in the tooth structure used in such back hoes, and specifically, though not exclusively, in back hoes of the type descrbied and depicted in the cited patent application.

Brief description of the present invention

The back hoe tooth structure of the present invention can be broadly described as including a point secured to, or formed integrally with, a base portion, and a drive rod member which is detachably connected to said base portion. Replacement of damaged points is thus facilitated. The drive rod member includes a head portion having a protuberant connector stud extending from one side thereof for connection to the base portion, and having an elongated rod connected to the opposite side of the head portion from the protuberant connector stud. The head portion of the drive rod member is characterized in having a dirt displacement face which extends at an acute angle to a plane extending normal to the longitudinal axis of the elongated rod.

In a more comprehensive aspect, the present invention relates to the combination of a plurality of the described tooth structures with a back hoe bucket. In this combination, the tooth structures are reciprocably mounted in juxtaposition to each other on the dirt engaging leading edge of the bucket. The bucket is characterized in having a face plate mounted at such leading edge through which the elongated rods of the drive rod members of the teeth are extended. The longitudinal axis of each elongated rod extends substantially normal to the face plate so that the dirt displacement faces of the head portions of the tooth structures each extend at an acute angle with respect to the plane of the face plate. This permits dirt and foreign matter to be more easily ejected from the space between the head portion of each tooth structure and the face plate during the retraction of the point of the tooth. The rod of each tooth structure drivingly engages a cam shaft which is rotatably mounted in a sealed chamber beneath the dirt supporting surface of the bucket.

From the foregoing description of the invention, it will be apparent that an object of the invention is to provide an improved tooth structure for use on back hoes which include structure for powering the teeth in a reciprocating movement.

Another object of the invention is to provide a tooth structure for use on back hoes, which tooth structure can be quickly replaced when damaged.

An additional object of the invention is to provide a back hoe apparatus having powered teeth which operate relatively freely of dirt impaction.

Additional objects and advantages of the invention will become apparent from the following detailed description of the invention when it is considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a back hoe bucket constructed in accordance with the present invention.

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1.

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2.

FIG. 4 is a sectional view taken along line 4—4 of FIG. 1.

FIG. 5 is a sectional view taken along line 5—5 of FIG. 2.

FIG. 6 is an exploded view of the tooth structure of the invention.

FIG. 7 is a perspective view of a tooth point and base portion forming a part of the tooth structure of the invention.

FIG. 8 is a perspective view of the drive rod member forming a part of the tooth structure of the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring initially to the drawings, and in particular, to FIG. 1, shown therein is a back hoe bucket designated generally by reference numeral **10**. The back hoe bucket **10** is connected by a suitable connection bracket **12** to the boom structure (not shown) of a back hoe in the manner illustrated and described in my co-pending application Ser. No. 722,990 filed Apr. 22, 1968, and entitled "Back Hoe Apparatus Having Movable Teeth." The back hoe bucket **10** is constructed similarly to that described in said co-pending application and thus includes a pair of substantially parallel side walls **14**, a dirt-carrying bottom wall **16** and an arcuate or curved back wall **18** which is preferably formed integrally with the dirt-carrying bottom wall **16**. The bucket **10** further includes a lower chamber wall **20** which, with the dirt-carrying bottom wall **16** and the lower portions of the side walls **14**, forms an open receiving chamber **22** which is open at its front end and at its back end. A removable arcuate closure plate **24** is constructed with a curvature in transverse dimension which perits it to be fitted to the lower portion of the bucket **10** in the manner best depicted in FIG. 2. Thus, the arcuate closure plate **24** has its forward edge secured to the rear edge of the lower chamber wall **20**, and has its rear edge secured to the lower edge of the arcuate back wall **18** of the bucket.

Positioned within the open receiving chamber **22** is a removable sealed driving unit designated generally by reference numeral **26**. The sealed driving unit **26** includes a casting block **28** which is an integrally cast element constructed to accommodate a prime mover, elongated drive rods connected to the digging teeth, and a cam shaft, all as more specifically described in co-pending U.S. application Ser. No. 722,990 to which reference has hereinbefore been made. Thus, the casting block **28** may be constructed with a transversely extending well **30** formed therein for the accommodation of a hydraulic motor **32**. The hydraulic motor **32** receives power fluid from a pair of hydraulic fluid supply conduits **34** and **36** which are connected through suitable fluid tight fittings **37** extending through the rear wall of the casting block **28**.

A cam shaft housing **38** is formed as a portion of the casting block **25** and is located in the central portion of the casting block. The cam shaft housing **38** is bored over its length to receive an elongated, generally cylindrical cam shaft **40** which is rotatably mounted in the described bore by means of a plurality of suitable bearing elements **42** (see FIG. 5). A portion of the cam shaft housing **38** at the center thereof is cut away to accommodate a driving chain **44** from the hydraulic motor **32**, which driving chain is extended around a suitable sprocket **46** keyed to the cam shaft **40**.

The details of construction of the cam shaft **40** are set forth in my co-pending application Ser. No. 722,990. It will suffice for purposes of explaining the present invention to point out that the cam shaft has cam surfaces spaced longitudinally therealong, which cam surfaces drivingly contact a plurality of horizontally spaced, elongated rods **50** forming portions of drive rod members designated generally by reference numeral **52**. Each drive rod member **52** further includes a head portion **54** which has formed integrally therewith, or suitably secured thereto, a protuberant connector stud **56** which projects horizontally from the head portion **54** on the opposite side thereof from the elongated rod **50**. Each of the elongated rods **50** extends through an annular sealing ring **58** and a tubular bushing **60**. The tubular bushings **60** are positioned in bores formed through the casting block **28**.

Extending across the front edge of the bucket **10** between the side walls **14**, and between the dirt-carrying bottom wall **16** and the lower chamber wall **20** is a face plate **62**. Disposed between the face plate **62** and the parallel forward face of the casting block **28** is a sealing gasket **64**. It will be noted that the elongated rods **50** are each extended through aligned or registering apertures or openings formed through the face plate **62** and the sealing gasket **64**.

For the purpose of limiting the reciprocating movement of each of the elongated rods **50** within its respective bushing **60**, a motion limiting pin **66** is extended through the dirt-carrying bottom wall **16**, through a rigid cover plate **68** which is extended across the top of the casting block to close the cavity containing the hydraulic motor **32**, through a sealing gasket **70**, through the casting block **28** through the bushing **60** and into a longitudinally extending slot **72** formed in the upper side of the respective rod **50**.

The remaining portion of the back hoe tooth structure of the invention is the leading portion of the tooth structure which includes a pyramidally shaped point **74** which is formed integrally with, or secured to, a rectangularly cross-sectioned base portion **76**. It will be noted in referring to the point **74** of the tooth structure that the four side faces of the point are triangular, and that the bottom or lower face of the point is inclined upwardly slightly with respect to the horizontal (see FIG. 4). It will also be noted in referring to FIG. 3 of the drawings that the upper faces of the points **74** constitute isosceles triangles, and that the base portions **76** of the several tooth structures are located in juxtaposition to each other so that very little dirt can pass between the base portions during operation of the back hoe in the manner hereinafter described.

The base portion **76** of the tooth structure of the invention is of generally rectangular configuration in vertical cross-section, and is secured to the base or large area portion of the point **74**. Preferably, the base portion **76** is formed integrally with the point **74**, and is of substantially the same cross-sectional area in vertical cross-section as is the area of the base of the pyramidally shaped point. The base portion **76** has a planar, substantially vertically extending face **78** on the opposite side thereof from the point **74** and extending into the base portion **76** from this face is a generally rectangularly cross-sectioned socket **84**. The socket **84** extends substantially horizontally, and is dimensioned to receive the protuberant connector stud **56** which projects horizontally from the head portion **54** of the drive rod member **52**. The protuberant connector stud is, of course, of a cross-sectional configuration to mate with the socket **84**.

A vertically extending pin aperture **86** extends downwardly through the bas portion **76** of the tooth structure and registers ith a pin aperture **88** formed in the protuberant connector stud **56** when the connector stud is forced into the socket **84** formed in the base portion **76**. An elongated securing pin **90** is then driven downwardly through the aligned apertures **86** and **88** to lock the drive rod member **52** to the base portion **76** of the tooth structure. The tooth structures when thus assembled, appear as shown in FIGS. 4 and 5.

It will be noted that the head portion **54** of the drive rod member **52** includes a substantially vertically extending planar face **54*a*** which carries the protuberant connector stud **56** and a rear face **54*b*** which extends substantially parallel to the face **54*a*** and which has secured therto, the elongated rod **50**. A pair of tapered dirt displacement faces **54*c*** and **54*d*** which are inclined at an acute angle with respect to the vertical intersect the face **54*b*** and complete the formation of the back side of the head portion **54**. It will be noted in referring to FIG. 4 that the dirt displacement faces **54*c*** and **54*d*** extend at an acute angle with respect to the plane of the face plate **62** or, stated differently, extend at an acute angle with respect to a plane extending normal to the longitudinal axes of the elongated rods **50**.

OPERATION

In the operation of the improved back hoe which incorporates the tooth structure of the present invention, the hydraulic motor **32** is driven by hydraulic power fluid delivered by one of the conduits **34** or **36** and discharged through the other of these conduits. As the hydraulic motor **32** is driven in rotation, the driving chain **44** is driven to cause the sprocket **46** keyed to the cam shaft **40** to be driven in rotation. The rotation of the cam shaft **40** in the bearings **42** causes the cam surfaces longitudinally along this cam shaft to contact the free ends of the elongated rods **50** forming a portion of the drive rod members **52**. As the high points on the cam surfaces of the cam shaft **40** move across the end faces of the elongated rods **72**, these rods are caused to reciprocate within the bushings **60**. The elongated rods **50** thus move outwardly and push before them, the head portion **54** of each of the drive rod members **52**. The cam surfaces formed on the cam shaft **40** are circumferentially staggered around the cam shaft so that the drive rod members are reciprocated out of phase with each other. This action is explained in greater detail in my co-pending U.S. application Ser. No. 722,990, to which reference has hereinbefore been made.

As the drive rod members **52** are reciprocated in the bushings **60**, they are extended outwardly through the openings in the face plate **62**. The stroke of each tooth structure is limited by the configuration of the cam surfaces on the cam shaft **40**, and by the movement limiting function of the motion limiting pins **66**. After reaching the outer end of its stroke, each tooth structure will be bearing against the earth ahead of the bucket **10**, and as the buck is moved toward this earth, a force is brought to bear on the point **74** of the tooth structure tending to force the tooth structure back in a retractive movement. The retractive movement is permitted by the configuration of the cam surface on the cam shaft **40**.

During the retractive movement, each elongated rod **50** moves inwardly within the bushing **60** and the head portion **54** of the drive rod member moves to a position adjacent the face plate **62**. It will be noted that the inclined dirt displacement faces **54***c* and **54***d* of each head portion **54** of each drive rod member **52** are, at this time, inclined at an acute angle with respective to the plane of the face plate **62**. The effect of this inclination is to develop a wedging action tending to wedge or force outwardly from between the head portion **54** and the face plate **62**, any dirt which may tend to pass between the head portion and the face plate. Dirt accumulation and impaction in this area are thus prevented by this configuration of the side of the head portion **54** to which the elongated rod **50** is connected.

At such time as the point **74** of a tooth structure may become damaged or blunted, such point may be quickly and easily replaced by simply removing the securing pin **90** which passes through the aligned or registered pin apertures **86** and **88**. This will permit the point **74** and base portion **76** to be pried off of the protuberant connector stud **56** which extends into the socket **84** formed in the base portion **76**. A new tooth point and base portion can then be quickly replaced on the drive rod member **52** by forcing the protuberant connector stud **56** into the socket **84**, and then driving the securing pin **90** into position through the registering pin apertures **86** and **88**.

What is claimed is:

1. In a back hoe of the type having a bucket, teeth reciprocably mounted at one edge of the bucket, and means mounted on the bucket for driving the teeth in reciprocation, the improved tooth structure characteristic of each of said teeth which comprises:

a pyramidally shaped point;

a rectangularly cross-sectioned base portion secured to said pyramidally shaped point; and

a drive rod member detachably secured to the base portion, said drive rod member comprising:

a head portion;

a protuberant connector stud projecting from one side of said head portion and connecting said head portion to said rectangularly cross-sectioned base portion; and

an elongated rod connected to the opposite side of said head portion from said protuberant connector stud, said head portion having at least one dirt displacement face adjacent the point of connection of said elongated rod thereto, said dirt displacement face extending at an acute angle with respect to the longiutdinal axis of said elongated rod.

2. The improvement in a back hoe defined in claim **1** wherein said base portion has a socket extending thereinto from the side thereof opposite said pyramidally shaped point, and wherein said protuberant connector stud extends into, and engages, said socket.

3. The improvement in a back hoe defined in claim **2** wherein the head portions of said drive rod members are positioned in juxtaposition to each other when all of said drive rod members are in transverse, horizontal alignment.

4. The improvement in a back hoe defined in claim **2** wherein there are a pair of said dirt displacement faces disposed on opposite sides of said elongated rod.

5. The improvement in a back hoe defined in claim **2** wherein said connector stud has a pin aperture formed therethrough, and said head portion has a pin aperture therethrough aligned with the pin aperture formed through said connector stud, and wherein said stud is connected to said head portion by a pin extended through said aligned pin apertures.

6. The improvement in a back hoe defined in claim **2** wherein said point has upper and lower faces shaped as isosceles triangles.

7. The improvement in a back hoe defined in claim **5** wherein there are a pair of said dirt displacement faces disposed on opposite sides of said elongated rod.

8. A back hoe bucket comprising:

a pair of opposed, horizontally spaced side walls;

a dirt-carrying bottom wall extending between the side walls;

a back wall extending between the side walls;

a lower chamber wall extending between the side walls and spaced downwardly from the bottom wall, and defining therewith an open receiving chamber;

a removable sealed driving unit positioned within said open receiving chamber;

a face plate secured between said side walls and between said dirt-carrying bottom wall and said lower chamber wall and closing one side of said open receiving chamber; and

a plurality of horizontally aligned tooth structures mounted through said face plate, each of said tooth structures comprising:

a pyramidally shaped point;

a rectangularly cross-sectioned base portion secured to said pyramidally shaped point; and

a drive rod member detachably secured to the base portion, said drive rod member comprising:

a head portion having a vertical cross-section which is rectangular in configuration;

a protuberant connector stud projecting from one side of said head portion and connecting said head portion to said rectangularly cross-sectioned base portion, said one side of said head portion from which said connector stud projects being planar and extending substantially parallel to said face plate; and

an elongated rod connected to the opposite side of said head portion from said one side from which said protuberant connector stud projects, said head portion having at least one dirt displacement face adjacent the point of connection of said elongated rod thereto, said dirt displacement face extending at an acute angle with respect to said face plate.

9. A back hoe bucket as defined in claim **8** wherein said removable, sealed driving unit contains:

a prime mover;

a cam shaft;

means drivingly connecting said prime mover to said cam shaft, said cam shaft being positioned for contacting and reciprocably driving said elongated rod of said tooth structure.

10. A back hoe bucket as defined in claim **9** wherein said face portion of each of said tooth structures has a socket extending thereinto from the side thereof opposite said pyramidally shaped point, and wherein said protuberant connector stud extends into, and engages, said socket.

11. A back hoe bucket as defined in claim **9** wherein said head portion of said drive rod members are positioned in juxtaposition to each other when all of said drive rod members are in transverse, horizontal alignment.

12. A back hoe bucket as defined in claim **11** wherein there are a pair of said dirt displacement faces disposed on said opposite sides of said elongated rod and on the opposite side of said head portion from said one side from which the said protuberant connector stud projects.

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U.S. Cl. X.R.

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