

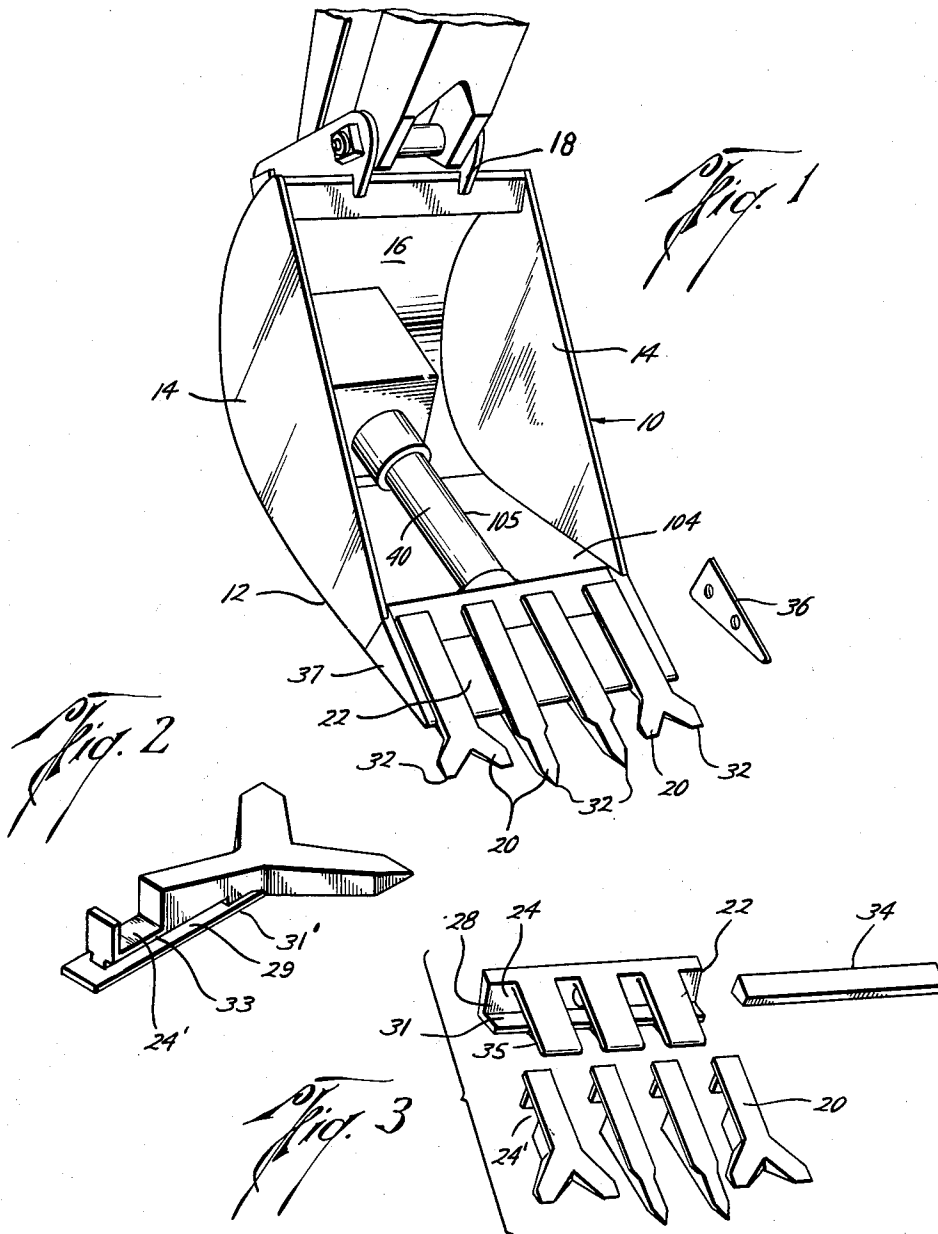
Nov. 27, 1962

C. W. PEWTERS
POWER EXCAVATING DEVICE

3,065,557

Filed July 1, 1960

4 Sheets-Sheet 1



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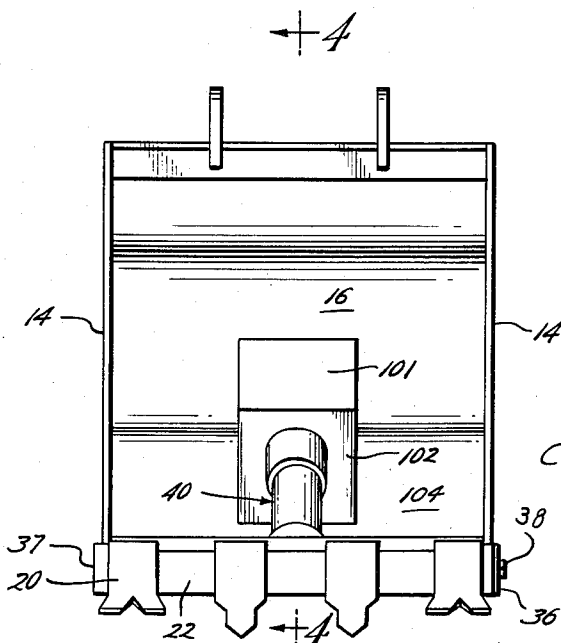
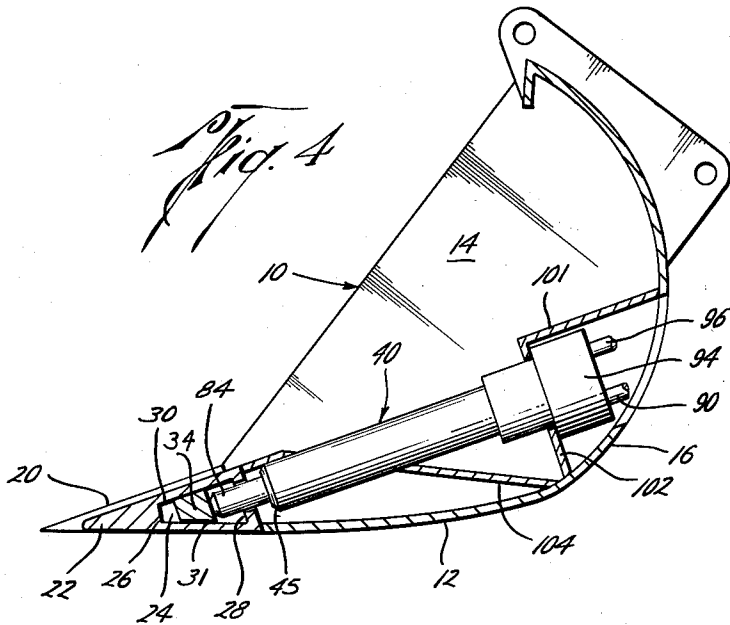
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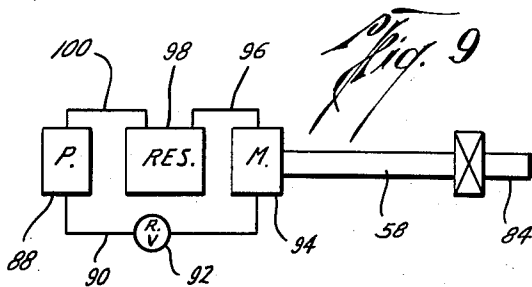
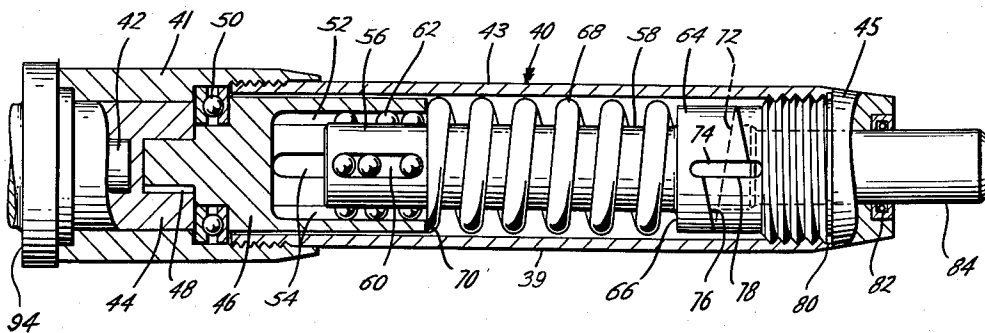
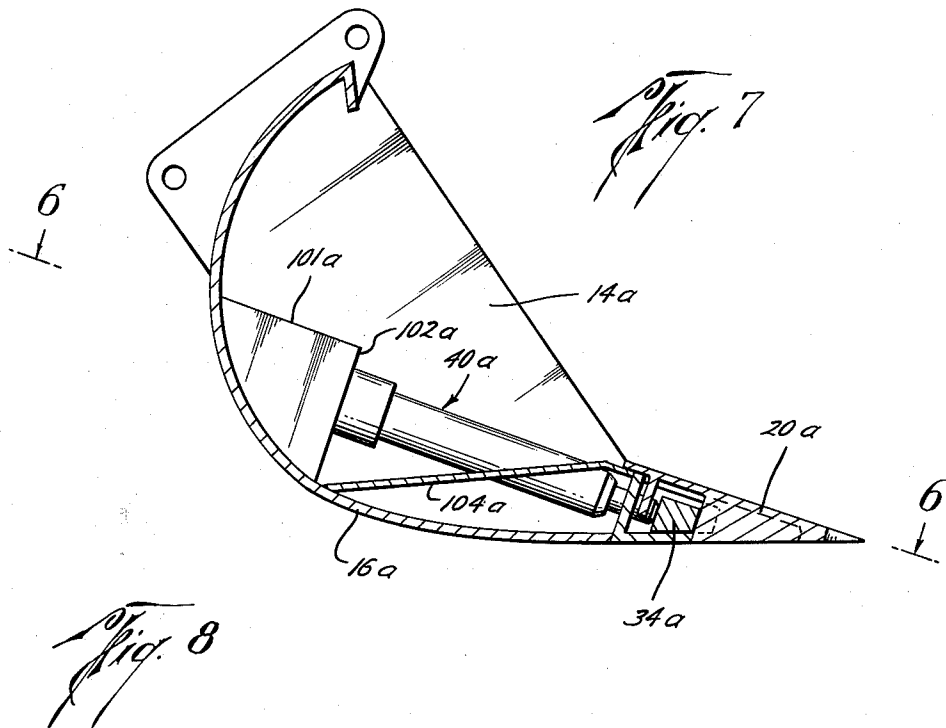
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POWER EXCAVATING DEVICE

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6 Claims. (Cl. 37-141)

The present invention relates to improvements in power excavating devices, and, more particularly, relates to improvements in power impact hammers and movable teeth mounted at the leading end of earth excavating devices.

Power driven excavating devices, such as shovels, front end loader buckets, shovel buckets, clam shells, back hoe buckets, and other types of shoveling and devices of the power type are in widespread use. In many instances, however, such excavating devices are ineffectual and substantially useless, for example, in digging in hard materials, such as frozen ground, frost lines, concrete surfaces, and hard rock formations such as caliche, limestone, iron ore, coral, and the like. On the other hand, when the earth is heavy-bodied and soggy and sticky, the movement of the bucket or shovel through the earth offers a viscous resistance, so that an extremely large amount of power is required to pass the shovel or bucket into and through the earth.

These problems are not satisfactorily solved by the use of bigger or larger equipment because the larger equipment cannot be used because of its bulky size, difficulties in transportation and cannot be used for work in close quarters. In addition, the provision of such larger equipment substantially increases the initial and operating costs.

While numerous movable teeth and power arrangements for moving the teeth have been proposed in the past for power type buckets and shovels, to my knowledge none has been successful to the extent that they have been accepted by the trade. This is probably due to one or more of the following. The prior devices are complicated, most of them do not have the required power to deliver the required impact, most of them are so large that they cannot readily be secured to power buckets and shovels without materially interfering with their operation otherwise, and most of these prior proposed devices require several power impact hammers, ordinarily one impact hammer for each movable tooth and require an outside power source, such as an air compressor.

The present invention is directed to a power excavating device which overcomes the disadvantages of the previously proposed arrangements mentioned above and which provides a very simple arrangement and assembly for providing tremendous impacting power by a relatively small and simple arrangement, which does not materially increase the size or bulk of the excavating device or appreciably reduce bucket capacity and yet enables it to dig through extremely hard formations and formations providing viscous resistance.

It is therefore an object of the present invention to provide a power excavating device which includes power driven impact teeth by which the device will readily and easily dig through extremely hard formations or formations offering viscous resistance which is relatively small, simple, compact and which does not materially increase the bulk of the excavating device or materially interfere with the normal functions of the excavating device.

Yet a further object of the present invention is the provision of an improved means for removably mounting teeth on the leading edge of a power excavating device by a very simple and ruggedly-efficient arrangement.

Yet a further object of the present invention is the provision of an impacting assembly to a power shovel or bucket

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in which movable teeth are removably held in position at the forward end of the bucket or shovel and by which the impact to the teeth is provided by one or more impacting hammers impacting a common anvil shaft which in turn impacts a large number of teeth with respect to the impacting hammers.

Yet a further object of the present invention is the provision of a power bucket or shovel having power driven impacting teeth adjacent its leading edge which are driven hydraulically by the hydraulic system of the power excavating machinery to which the power bucket or shovel is connected, for example, tractors and the like.

Yet a further object of the present invention is the provision of an improved power excavating device which is of relatively small size by which tremendous digging or penetrating power is provided for penetrating extremely hard formations or formations offering viscous resistance.

Yet a further object of the present invention is the provision of mounting arrangements which removably mounts teeth on the leading end of a power shovel or bucket and in which the mounting means serves as a hammer member for the teeth and an anvil member for the impacting device.

Yet a further object of the present invention is the provision of a power bucket or shovel provided with impacting teeth which is of relatively small size, simple in design, ruggedly efficient in use and which will penetrate extremely hard formations and formations having a viscous resistance to digging.

Yet a further object of the present invention is the provision of a power shovel or bucket which includes movably-mounted bucket teeth and one or more hydraulic impact hammers driving the teeth in which their housings are carried by the bottom wall and extend through the back wall or a portion thereof of the shovel or bucket with the hydraulic motors and lines being located behind the back wall or portion thereof and above the bottom wall thereby providing minimum interference with normal digging of the shovel or bucket.

Other and further objects, features and advantages of the invention will be apparent from the following description of presently-preferred embodiments of the invention, given for the purpose of disclosure, and taken in conjunction with the accompanying drawings, in which like character references designate like parts throughout the several views, and where

FIGURE 1 is a perspective view illustrating a power excavating or digging device according to the invention,

FIGURE 2 is a perspective view illustrating the bottom of a bucket tooth of FIGURE 1,

FIGURE 3 is a fragmentary, exploded view, illustrating the connecting assembly of FIGURE 1 connecting the bucket teeth to the leading edge of the power bucket,

FIGURE 4 is a side elevational view, partly in section, illustrating the power excavating or digging device of FIGURE 1 and taken along line 4-4 of FIGURE 5,

FIGURE 5 is a front elevational view of the power excavating or digging device of FIGURE 4,

FIGURE 6 is a top sectional view illustrating a modified power excavating or digging device according to the invention and taken along line 6-6 of FIGURE 7,

FIGURE 7 is a cross-sectional view taken along the line 7-7 of FIGURE 6,

FIGURE 8 is a side view, mostly in section, illustrating a highly satisfactory impact hammer for mounting in the excavating and digging devices of FIGURES 1-7, and

FIGURE 9 is a hydraulic flow circuit satisfactory for use in providing hydraulic power to the hydraulic motor of the impact hammer illustrated in the preceding figures.

Referring now to the drawings, and particularly to FIGURE 1, a power excavating device, such as the bucket or

shovel, generally designated by the reference numeral 10, is provided which is of the back hoe type. That is, it is the type of shovel which is utilized in digging in a backward direction, that is a direction toward the machine, such as a tractor, to which the bucket is connected.

The power bucket 10 may take any desired shape and, ordinarily, includes the bottom 12, the sides 14, the back 16, and suitable bracket or connecting elements 18 by which the power bucket 10 is connected to suitable power driven linkage, not shown, connected to suitable power excavating machinery, for example, a tractor (not shown) in the conventional manner.

Since the particular shape or configuration of the power bucket as such does not constitute the present invention and the principles of the invention may be applied to any power bucket or shovel, no further description thereof is deemed necessary or appropriate. As will be apparent later, however, the power impact means is combined with the power bucket in such a manner to provide minimum interference with the normal excavating function of the bucket 10 and to provide a minimum of loss in bucket capacity.

In accordance with the present invention the movable bucket teeth or digging elements, generally indicated by the numeral 20, are secured to the leading end 22 of the power bucket 10 by a connecting assembly including a generally transversely-extending slot 24 as best seen in FIGURE 4, formed by the front and back walls 26 and 28, the upper wall 30 and the bottom wall 31.

In order to provide a relatively sharp forward edge 32 and still provide sufficient strength to the teeth 20, they are formed generally, when viewed in longitudinal section, in a triangular shape. Thus, sufficient strength is provided adjacent the leading portions 32 of the teeth 20 and they are of sufficiently large size to accommodate the slots 24' (FIGURE 2) which form a continuation of the slot 24 when assembled. As shown in FIGURES 3 and 4, an anvil bar 34 extends across and adjacent the leading end 22 of the power bucket 10 through the slots 24 and 24'. The anvil bar 34 is prevented from moving out of the slot 24 by contacting the inner side of the side wall 37 and at the other end by the removable side wall 36. Thus, the anvil bar 34 is secured in the slot 24 and through the slots 24' in the teeth 20 and is permitted limited reciprocating motion generally in a backward and forward direction of the teeth 20, the plate 36 being removably secured to the forward portion of one side 14 of the bucket 10 such as by the nuts and bolts 38 (FIGURE 5) so that the anvil bar 34 may be removed to release the teeth 20.

Each of the teeth 20 are provided with the longitudinally-extending slots 29 on each side formed by the longitudinally-extending flanges 31' and 33 in which the longitudinally-extending flanges 35 at the sides of the forward end 22 slidably fit. Thus, a plurality of digging teeth 20 is secured to the leading digging end 22 of the bucket 10 by simply placing these teeth in position as shown in FIGURE 1 and sliding the anvil bar 34 through the openings 24 provided therein. If desired, the leading end 22 may be formed separately from the bucket 10 and secured thereto as shown or formed in the leading end of the bucket.

Advantageously the arrangement described for mounting a plurality of the teeth 20 serves to impact or move the teeth 20 simultaneously and, if desired, by a single impacting hammer such as generally designated by the reference numeral 40.

The details of a highly effective impact hammer 40 are illustrated in FIGURE 8. A housing 39 is provided which includes the motor housing 41 and the cylindrical shaft housing 43. Motor housing 41 carries the hydraulic motor 94 which is provided with the output shaft 42 which is connected by the flexible coupling 44 to the combined rotor and coupling 46, such as by the splines 48, so that rotation is transmitted from the output shaft 42 through

the flexible coupling 44 to the combined rotor and coupling 46.

An antifriction assembly generally designated by the reference numeral 50 is provided adjacent the inner end of the combined rotor and coupling 46 which, of course, reduces friction and particularly any thrust action imparted to the combined rotor and coupling 46.

A counterbore 52 is provided in the outer end of the combined rotor and coupling 46 which is provided with a plurality of axially-extending grooves 54 for reception of the inner end 56 of the impact shaft 58, the inner end of which is provided with the complementary set of mating and axially-extending grooves 60 in which the antifriction elements such as the balls 62 are provided. Thus, rotation is imparted from the combined rotor and coupling 46 to the impact shaft 58 but yet limited axial movement of the impact shaft 58 is permitted with respect to the bushing and rotor 46.

The impact shaft 58 is provided with an annular enlargement 64 intermediate its ends and includes the inwardly facing annular shoulder 66 which serves as a stop for the compression spring 68 or energy storing means disposed about the impact shaft 58, the other end of which stops against the outwardly facing annular shoulder 70 of the combined rotor and coupling 46.

The outwardly-facing portion of the enlarged intermediate section 64 of the impact shaft 58 is provided with a suitable rotary jar mechanism which includes a single cam face 72 which is in the form of an annular inclined cam face or helix and includes a single abrupt axially-aligned shoulder surface 74 which permits abrupt axial travel of the shaft in an outward direction in response to the action of the coil spring 68 or energy storing means.

The impact shaft 58 and a portion of the combined rotor and coupling 46 are disposed within a generally cylindrically-shaped shaft housing member 43 which, preferably, is releasably secured to the motor housing member 41, such as by threading as illustrated, so that the various parts may readily and easily be assembled or replaced and repaired.

The shaft housing member 43 includes the nose cone 45 which, preferably, is releasably secured to the body member 43, such as by threading as illustrated, again for the purpose of ease of assembly and making repairs and replacement of parts.

The nose cone 45 is provided with a cooperating or mating cam face 76 which is complementary to the cam face or surface 72 and, accordingly, is in the form of an annular inclined cam face or helical face which is provided with the single, abrupt, axially-aligned shoulder surface 78.

The nose cone 45 is provided with suitable seals 80 adjacent its threaded portion and is provided with the seal 82 at its outer inner end through which the outer end 84 of the impact shaft 58 extends.

Thus, actuation of the hydraulic motor 94 rotates the power output shaft 42 and the impact shaft 58 through the flexible coupling 48 and combined rotor and coupling 46, including the antifriction elements 60, whereby the cam surfaces 72 and 76 alternately compress and release the compression spring 68 or energy storing means thereby providing an abrupt impacting movement of the impact shaft 58 in an outer direction only.

At the present time a large number of excavating devices, such as power buckets and shovels, are actuated by machinery including a hydraulic system. The impact hammers described and shown advantageously use the hydraulic system of the machinery, for example, a tractor to which the power bucket or shovel is connected.

Referring now to FIGURE 9, a typical and satisfactory hydraulic system is illustrated which includes a suitable hydraulic pump 88 which is connected by the hydraulic line 90 through the regulating valve 92 to the hydraulic motor 94. A hydraulic return line 96 returns hydraulic

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liquid from the motor 94 into the hydraulic reservoir 98 which includes the hydraulic flow line 100 leading to the hydraulic pump 88.

In present day equipment, the hydraulic controls are located conveniently to the operator, for example the controls for manipulating the power bucket, as well as the control valve 92. Thus, the impact hammer is controlled as desired by the operator at the control position of the machinery to which the power bucket or shovel is connected, and advantageously operated as desired.

The impact hammer illustrated in FIGURES 5 and 6 is particularly suited and adapted for use in power shovels and buckets according to the present invention in view of the fact that it occupies very small space, delivers tremendous power and impacts of an order sufficient to provide a highly practicable and workable tool and is readily and easily operated from the operator controls with a minimum of alteration or adaptation of the machinery involved.

Referring again to FIGURE 4, the impact hammer 40 is mounted on or closely adjacent the bottom wall 12 of the power bucket 10 with the hammer end 84 extending out of the nose cone 45 and in engagement with the anvil bar 34 so that actuation of the impact hammer 40 causes the hammer 84 to hammer the anvil bar 34 which, in turn, hammers the teeth 20.

As illustrated, the body of the impact hammer is preferably disposed completely within the outer confines of the power bucket or shovel 10, a well 101 being provided at the central portion of the back 16 in which the hydraulic motor 94 is mounted. Preferably, the motor housing 94 is connected to the back side of the wall 102 of the well 101. In order to provide a smooth inner bottom and to prevent dirt, liquids and the like from becoming entrapped under and around the body of the impact hammer 40, a false bottom 104 is provided as shown with a slot 105 (FIGURE 1) to receive the impact hammer 40. If desired, the motor may be mounted behind the back wall 16, it only being necessary that the motor 94 be mounted at the rearward portion of the bucket 10 and behind a wall portion to preferably prevent earth and the like from contacting the motor 94 and hydraulic lines 90 and 96. Thus, the combined bucket, impacting device and teeth mounting arrangement advantageously provide a minimum of interference with normal excavating or digging operations, yet provide a highly effective impacting arrangement for a power bucket or digging device.

Thus, upon contacting a particular formation or surface through which it is desired to dig, the operator needs merely to position the power bucket or shovel 10 to engage the surface in the usual manner for digging, and then actuate the impact hammer 40 which in turn impacts and drives the digging elements 20 in a forward direction.

As previously mentioned, while for many uses and applications only a single impact hammer 40 is required to provide the necessary impacting force through the mounting arrangement illustrated, more than one such impacting hammer may be utilized, if desired, such an arrangement being illustrated in FIGURES 6 and 7, to which reference is now made. In these figures, the reference letter "a" is added to those parts corresponding to those of FIGURES 1-5, 7 and 8. Essentially, as shown in FIGURE 6, the same arrangement is utilized as in FIGURES 1-5, inclusive, except that the power bucket or shovel 10a is considerably wider than that illustrated in FIGURES 1-5, inclusive, and includes additional and more widely spaced digging elements or teeth 20a. In this arrangement, two impact hammers 40a impact one or more anvil shafts 34a, the hydraulic motors 94a of which are connected by suitable hydraulic lines, not shown, to the hydraulic system of the machinery to which the power bucket 10a is attached, such as a tractor.

The remaining parts, structural arrangement and mode of operation are the same as that described in connection with FIGURES 1-5, 7 and 8, except that a plurality of

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impact hammer units 40a and one or more anvil shafts 34a are used instead of a single impact unit 40. Accordingly, no further detailed description of this modification is deemed necessary or appropriate.

As previously mentioned, power excavating and digging devices according to the present invention have been highly satisfactory in use in that a very small device is, in effect, made to do a very large job which cannot be done by a large device because of the latter's size, difficulty of transportation, inability to use in close quarters, extreme expense and the like. In addition, a power device according to the present invention has been highly satisfactory in penetrating extremely hard materials and formations for example concrete, caliche, iron ore, coral, limestone, frost lines and various other hard ground formations which heretofore could not successfully be penetrated by previous power buckets and shovels.

The mounting arrangement for the power buckets and shovels can, of course, be used with other type impacting hammers. It is highly advantageous and particularly suited to use with a hydraulic impact hammer of the type described and illustrated in view of the compact size and ability to combine it with a power bucket or digging device as mentioned, the impact power generated, and the ability of providing varying rates of impact under various conditions with a minimum loss of power.

The present invention, therefore, is well suited and adapted to attain the ends and objects and has the advantages and features mentioned as well as others inherent therein.

While presently preferred embodiments of the invention and representative uses and applications have been given for the purpose of disclosure, other uses and applications and changes in details of construction and arrangement of parts may be made which are within the spirit of the invention as defined by the scope of the appended claims.

What is claimed is:

1. An excavating bucket adapted for connection to a power driven excavating apparatus and having side, bottom and back walls defining a chamber with an open front portion for receipt of earth and the like through said portion into said chamber, a plurality of bucket teeth carried by the bottom wall and projecting forwardly in advance of the leading edge of the bottom wall, an anvil member, each bucket tooth having an anvil receiving slot for detachably holding the teeth to said anvil, means mounting the anvil member relative to the bottom wall for limited movement in a direction projecting the bucket teeth forwardly of the leading edge of the bottom wall, a housing carried by the bottom wall and extending rearwardly through a portion of the back wall, a rotary jar mechanism in the housing including an impact hammer spaced from the anvil member for impacting the anvil member in the forward direction of the bucket teeth, a rotatable hydraulic motor driving the rotary jar mechanism connected to the housing and disposed rearwardly of said portion of the back wall and above the bottom wall, and means on the motor disposed rearwardly of said portion of the back wall and above the bottom wall for connection to a source of hydraulic pressure for rotating the rotary jar mechanism.

2. In combination with an excavating bucket; a wall adapted for receipt of earth and the like, a tooth receiving structure carried forwardly of said wall, a plurality of teeth, each of said teeth being slidably and detachably carried by said structure for vibratory movement with respect thereto, an impact means positioned adjacent said teeth for impacting said teeth forwardly, a rotary jar mechanism carried by said wall and positioned rearwardly of said teeth and including an impact hammer spaced from said impact means, an energy storing means for driving said impact hammer forwardly against said impact means, and a rotary hydraulic motor drivingly connected to said

rotary jar mechanism for actuating the energy storing means.

3. In combination with an excavating bucket; a wall adapted for receipt of earth and the like, a tooth receiving structure carried forwardly of said wall, a plurality of teeth, each of said teeth being slidably and detachably carried by said structure for vibratory movement with respect thereto, an impact means positioned adjacent said teeth for impacting said teeth forwardly, a retractable impact hammer, an energy storing means normally driving said impact hammer forwardly against said impact means, a rotary jar mechanism carried by said wall and positioned rearwardly of said teeth and connected to said retractable impact hammer for retracting said hammer from the impact means, and a rotary hydraulic motor drivingly connected to the rotary jar mechanism for alternately actuating and releasing the energy storing means and impact hammer.

4. An excavating bucket adapted for connection to a power driven excavating apparatus and having side, bottom and back walls defining a chamber with an open front portion for receipt of earth and the like, a plurality of bucket teeth, each of said teeth being slidably carried by the bottom wall and projecting forwardly in advance of the leading edge of the bottom wall, an anvil member carried by the bottom wall and positioned adjacent said teeth for impacting said teeth forwardly, a housing carried by the bucket, a rotary jar mechanism in the housing including a retractable hammer adapted to be spaced from the anvil member for impacting the anvil and teeth in the forward direction, and spring means positioned coaxially with and normally driving the hammer forwardly, and a rotatable hydraulic motor connected to and driving the rotary jar mechanism.

5. In combination with an excavating bucket; a wall adapted for receipt of earth and the like, a plurality of bucket teeth slidably carried by said wall and projecting forwardly in advance of the leading edge of the wall, an impact means positioned adjacent said teeth for impact-

ing said teeth forwardly, said impact means detachably connecting the teeth to said wall, a rotary jar mechanism carried by the bucket and positioned rearwardly of said teeth and including a retractable impact hammer, said hammer spaced from the impact means when retracted, an energy storing means for driving said impact hammer forwardly against said impact means, and a rotary hydraulic motor drivingly connected to said rotary jar mechanism for actuating the energy storing means.

6. In combination with an excavating bucket; a wall adapted for receipt of earth and the like, a tooth connecting assembly carried by the wall, said assembly having a plurality of tooth receiving slots for receiving teeth, a bucket tooth slidably carried in each of said slots and projecting forwardly in advance of the leading edge of the wall, an impact receiving means detachably connected to each of the teeth and supported by the assembly for limited movement in a direction for projecting the bucket teeth forwardly of the leading edge of the wall, a housing carried by the bucket, a rotary jar mechanism in the housing including a retractable hammer adapted to be spaced from the impact receiving means for providing impact to the teeth in the forward direction and including an energy storing means for driving said impact hammer forwardly, and a rotatable hydraulic motor in the housing and connected to and driving the rotary jar mechanism.

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