United States Patent [19]

Clark

[11] **3,724,899**

[45] **Apr. 3, 1973**

[54] TOOTH FOR BACKHOE BUCKET

[76] Inventor: **Harry C. Clark**, 226 W. Perry St., Belvidere, Ill.

[22] Filed: **May 14, 1971**

[21] Appl. No.: **143,388**

[52] **U.S. Cl.** **299/26,** 37/117.5, 299/67

[51] **Int. Cl.** **E02f 3/32**

[58] **Field of Search**.....299/26, 67; 37/117.5, 142 R, 37/141 T, 2 R

[56] **References Cited**

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3,044,192	7/1962	Moore	37/2 R
3,403,940	10/1968	Clark	299/26

Primary Examiner—Ernest R. Purser
Attorney—Wolfe, Hubbard, Leydig, Voit & Osann

[57] **ABSTRACT**

A backhoe type excavator includes a digging bucket adapted to dig through frozen earth, limestone and the like by the operation of the normal actuators of the excavator. Detachable saws are mounted on the two side panels of the bucket to cut through the frozen earth during back and forth movement of the bucket. A ripper tooth on the lower lip of the bucket then is pulled across the earth between the two resulting cuts or kerfs to break loose the frozen earth, and the tooth thereby coacts with the saws to excavate an initial hole of predetermined size through the frost line. As the initial hole is enlarged to form a trench or the like, new kerfs are cut in the frozen earth at the edge of the initial hole and the tooth is driven in between the lower ends of the kerfs to break loose a relatively large chunk of frozen earth which thereby falls into the bucket for subsequent removal. To facilitate digging through limestone, the ripper tooth extends forwardly of the lower lip at a substantial angle inclined relative to a row of teeth fixed to the lip. When digging, the bucket is drawn repeatedly across the surface of the limestone with the tooth and teeth on successive passes alternately positioned to dig into and rip loose the limestone to form the trench.

8 Claims, 16 Drawing Figures

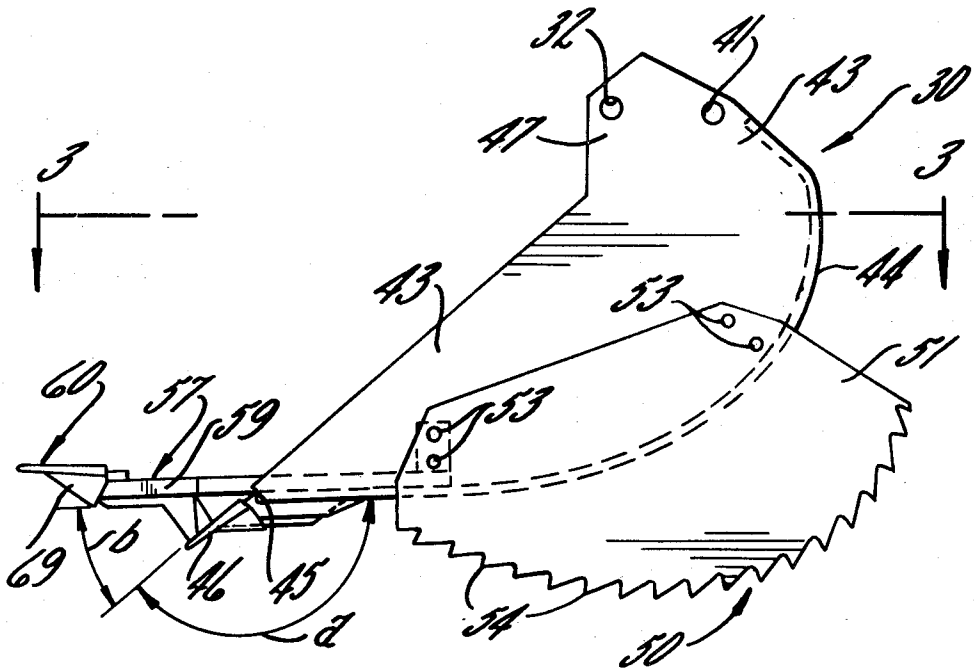
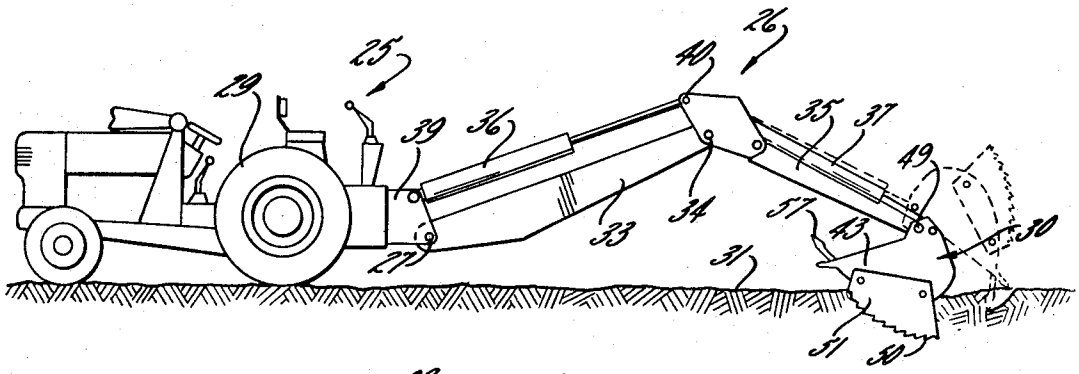


Fig. 1.



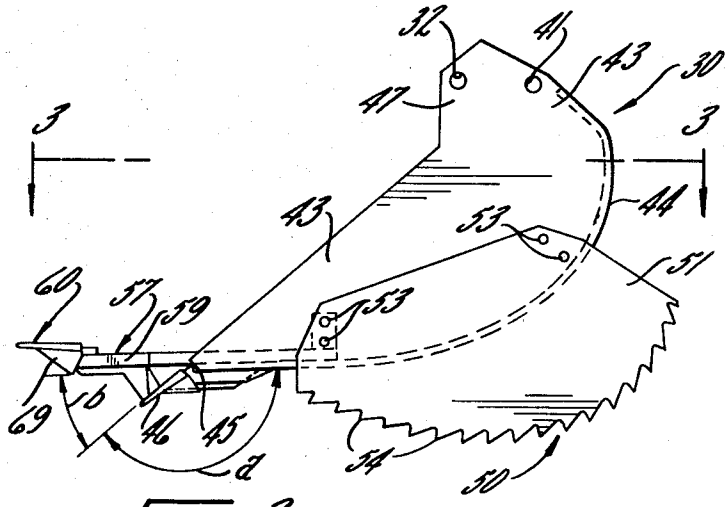


Fig. 2.

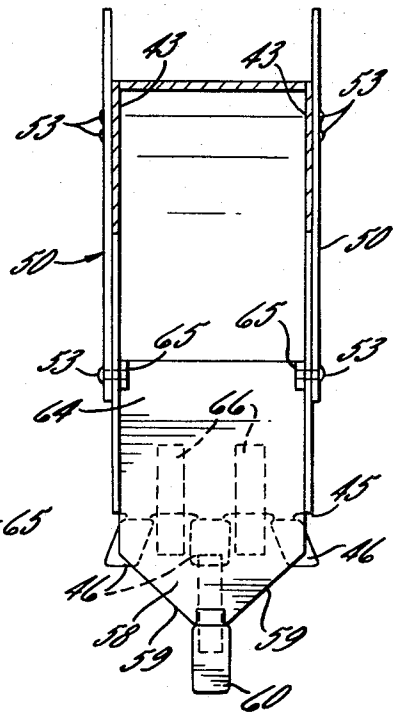


Fig. 3.

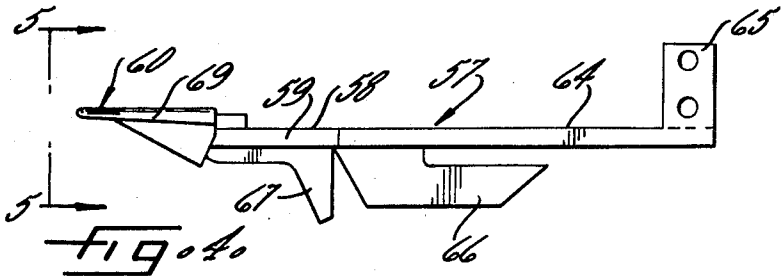


Fig. 4.

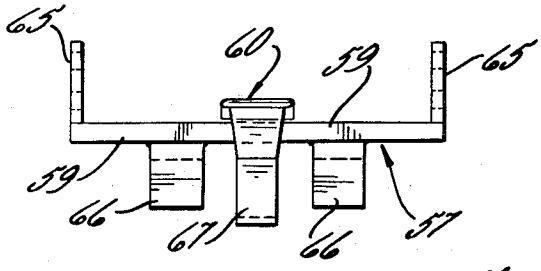


Fig. 5.

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FIG. 6

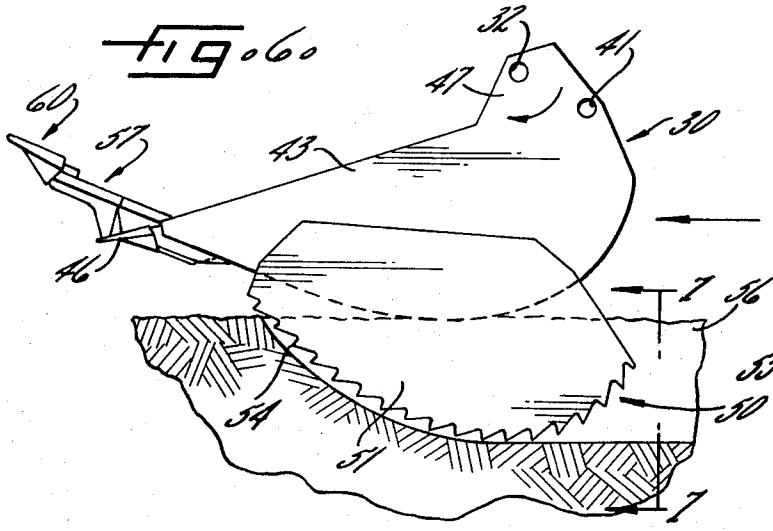


FIG. 7

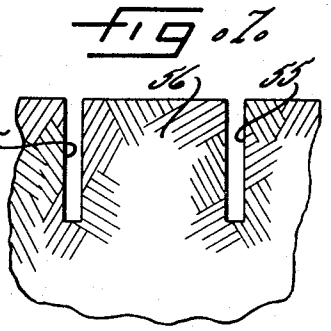


FIG. 8

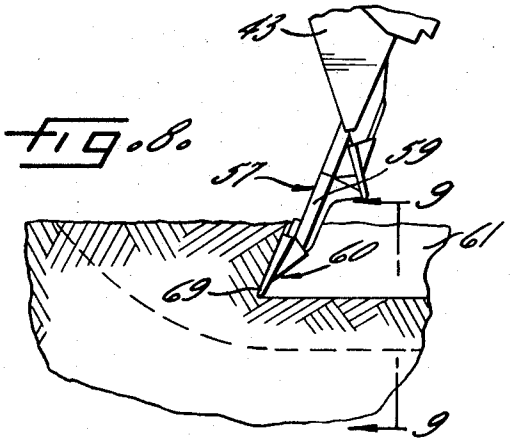
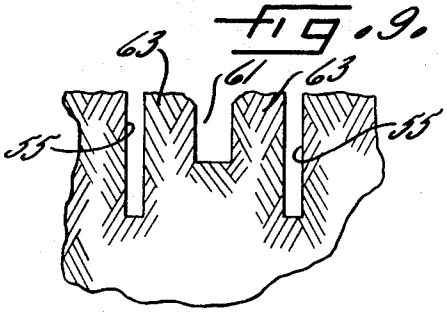


FIG. 9



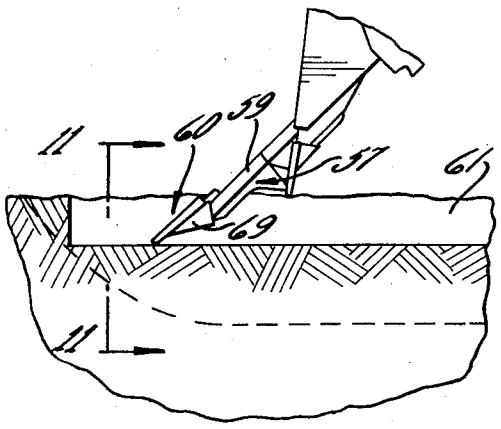
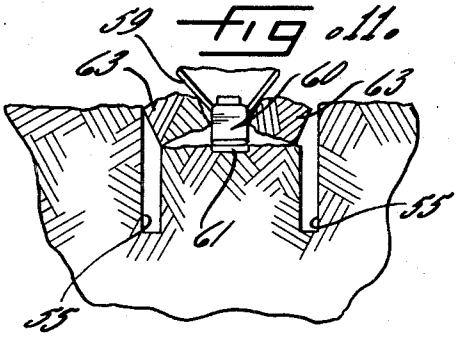


FIG. 10

FIG. 11



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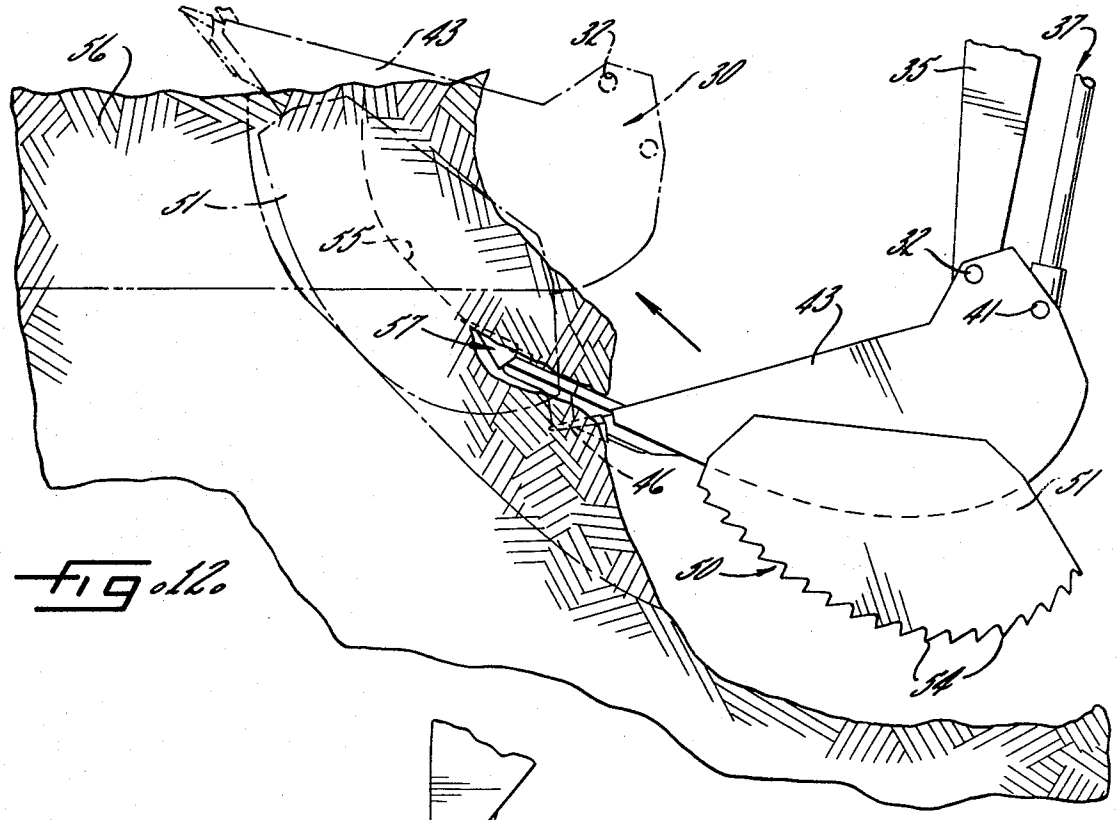

Fig. 12

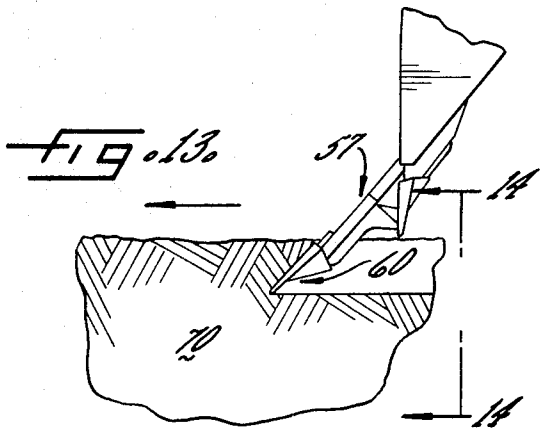

Fig. 13

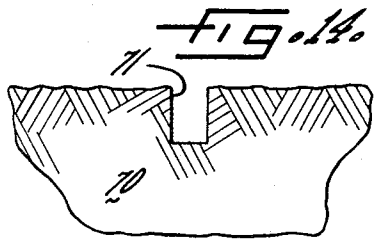

Fig. 14

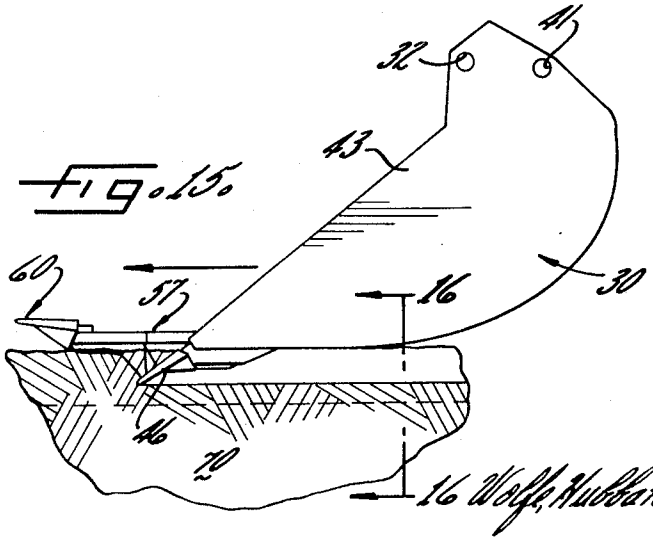

Fig. 15

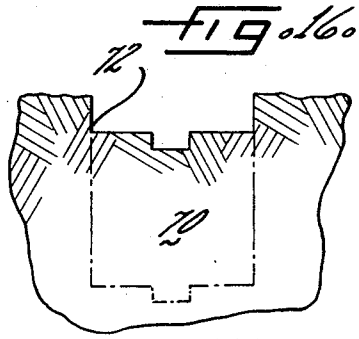

Fig. 16

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TOOTH FOR BACKHOE BUCKET

BACKGROUND OF THE INVENTION

This invention relates generally to the removal of frozen earth, rock and the like preparatory to and during the digging of a trench or other excavation with a backhoe excavator. More particularly, the invention relates to an excavator bucket used in the excavation of such a trench wherein the bucket includes a pair of spaced saw blades which are attached to the side panels of the bucket by bolts and are used for cutting spaced kerfs in the frozen ground so as to define a tongue of frozen earth which is subsequently broken loose and removed. An excavator bucket of this general type is shown in my U.S. Pat. No. 3,403,940.

SUMMARY OF THE INVENTION

The general object of the present invention is to provide a new and improved excavator bucket which is particularly adapted to more efficiently and rapidly excavate frozen earth, rock and the like than is possible with prior buckets. A more detailed object is to excavate frozen earth more rapidly through the provision of a bucket having a novel ripper tooth which coacts in a unique manner with a pair of bucket-mounted saws to break loose chunks of frozen earth from between sawed kerfs as the bucket is drawn across the exposed surface of the frozen earth.

Another object is to position the ripper tooth uniquely with respect to the ordinary digging teeth of the bucket such that the tooth and the teeth may coact with one another to facilitate the digging of a trench in rock.

A further object is to simplify the bucket by detachably mounting the ripper tooth on the bucket through the use of the same fasteners which are used to mount the saws on the bucket.

These and other objects and advantages will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a backhoe excavator with a digging bucket embodying the novel features of the present invention.

FIG. 2 is an enlarged side elevational view of the digging bucket.

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

FIG. 4 is an enlarged side elevational view of parts of the digging bucket.

FIG. 5 is an end view taken substantially along line 5—5 of FIG. 4.

FIG. 6 is a side elevational view of the digging bucket and showing one step of an excavating operation.

FIG. 7 is a cross-section of the earth as taken substantially along line 7—7 of FIG. 6.

FIG. 8 is a view similar to FIG. 6 but showing another step of the digging operation.

FIG. 9 is a cross-section of the earth as taken substantially along line 9—9 of FIG. 8.

FIG. 10 is a similar view to FIG. 6 but showing still another step of the digging operation.

FIG. 11 is a cross-section of the earth as taken substantially along line 11—11 of FIG. 10.

FIG. 12 is a fragmentary side elevational view of the bucket and excavator and showing the final step of the digging operation.

FIG. 13 is a fragmentary side elevational view of the bucket and showing the bucket in a second type of digging operation.

FIG. 14 is a cross-section of the earth as taken substantially along line 14—14 of FIG. 13.

FIG. 15 is a view similar to FIG. 13 but showing a second step in the second type of digging operation.

FIG. 16 is a cross-section of the earth as taken substantially along line 16—16 of FIG. 15.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawings for purposes of illustration, the present invention is embodied in a backhoe type excavator **25** in which an articulated boom **26** is pivoted at **27** on the rear end of a tractor **29** and carries a digging bucket **30** that is pivoted on the lower free end of the boom for digging engagement with the earth **31**. The general construction and operation of such excavators are well known and thus will be described only briefly herein.

The boom **26** is formed by an elongated main arm or mast **33** fulcrumed at one end on the pivot **27** for vertical swinging and having a horizontal pivot **34** at its free end supporting the second arm **35** of the boom, the latter arm commonly being called a dipper stick. The bucket **30**, in turn, is mounted to swing on the lower end of the dipper stick about a generally horizontal pivot **32** (FIG. 2).

With the foregoing arrangement, vertical movement of the bucket **30** is accomplished with the usual operating mechanism including hydraulic cylinders **36** and **37**. The cylinder **36** acts between a platform **39** on the rear of the tractor **29** and a pivot **40** on the upper end of the dipper stick **35** to swing the latter toward and away from the tractor. The cylinder **37** is fastened at one end to the upper portion of the dipper stick and at the other end to the bucket to rock or curl the bucket about its pivot **32**. Additional cylinders (not shown) act between the platform **39** and the mast **33** to swing the latter upwardly and downwardly and, to swing the boom **26** from side-to-side, the operating mechanism also includes a power actuator (not shown) for rotating the platform about a vertical axis.

The bucket **30** is formed by two side panels **43** (FIG. 3) disposed in vertical planes and spanned by a generally curved plate **44** which forms the rear side and bottom of the bucket. At the front side of the bucket, the plate terminates in a digging edge or lower lip **45** which, in the present instance, has mounted thereon three horizontally spaced and, forwardly extending teeth **46**, the latter being angled downwardly relative to the plate at an obtuse included angle *a* of approximately 145°. The top of the bucket is open and an upstanding ear **47** is formed integrally on the top of each side panel. A pivot pin **49** extends through the ears to connect the bucket to the dipper stick **35**.

Two saws **50** are mounted on the side panels **43** in two parallel planes spaced apart a distance approximately equal to the width of the bucket **30** in a position for cutting engagement with the earth **31** as the bucket is curled about its pivot **32** and swung toward the trac-

tor 29 by the normal operating actuators of the excavator 25. Herein, the saws are formed on heavy metal plates 51 and are detachably fastened to the outer sides of the side panels 43 by bolts 53 projecting through the side panels. The lower edges of the plates are curved, generally on an arc concentric with the bucket pivot, and are notched or serrated to form a series of saw teeth 54. As the bucket is curled, the teeth cut a pair of parallel slots or kerfs 55 (FIGS. 6 and 7) in the exposed surface of the earth to define an elongated tongue 56 of frozen earth. The latter then is removed to open an initial hole which is subsequently enlarged to form a trench.

In accordance with the present invention, a ripper tooth 57 is mounted on and extends forwardly of the lower lip 45 of the bucket 30 and coacts in a novel manner with the saws 50 to open the initial hole through the frozen earth by quickly breaking loose and removing the tongue 56 after the kerfs 55 have been formed by the saws. In this instance, the tooth includes a forward end portion 58 (FIG. 3) with two side edges 59 which converge toward one another forwardly of the lip 45, and further includes a wedge-shaped tip 60 on the forward ends of the side edges. The tongue defined between the kerfs 55 is removed by alternately gouging a longitudinal groove 61 (FIGS. 8 and 9) in the exposed surface of the tongue with the tip 60 and wedging the side edges 59 within the groove and along the length thereof to break loose the frozen earth or shoulders 63 standing between each kerf 55 and the groove (see FIGS. 10 and 11). This process is repeated with the kerfs being deepened as necessary until the resulting hole is opened through the frost line. Thus, the initial hole in the frozen earth is formed rapidly and efficiently by normal operation of the excavator 25 itself and without the need of other special equipment or procedures.

In the present instance, the tooth 57 is detachably mounted within the bucket 30 between the side panels 43 and adjacent the bottom plate 44 so that the forward end portion 58 is centered above the lip 45 and extends forwardly past the teeth as shown in FIG. 3. More particularly, the tooth is formed as a thick metal plate with the forward end portion being generally triangular in shape and a generally rectangular rearward end portion 64 of predetermined width to fit between the side panels. Parallel upstanding members or wings 65 are welded to the sides of the rearward end portion and receive the bolts 53. As a result, the tooth is advantageously anchored to the bucket with some of the same bolts which are used to mount the saws 50 on the outer walls of the side panels.

As shown in FIGS. 3 and 4, the forward end portion 58 is centered above the row of teeth 46 between the end teeth by means of two L-shaped keepers 66 fastened on the underside of the tooth and interengaging the lip 45 between the teeth to hold the forward end portion from moving upwardly or laterally relative to the bucket during excavation. To keep the forward end portion and tip 60 from breaking off or being bent toward the teeth, a triangular stud 67 on the underside of the forward end portion preferably engages the center one of the teeth 46 to thereby provide a firm support for the tooth 57. This arrangement also has the advantage of transmitting most of the force applied to the tooth during excavation through the bottom plate 44 rather than directly to the bolts 53 so that the connection of the tooth with the bucket is very sturdy.

To open the initial hole in the surface of the frozen earth 31, the excavator 25 is operated first to curl the bucket in a back and forth movement to saw the spaced kerfs 55 in the earth (FIGS. 6 and 7). Then, when forming the groove 61, the normal actuators of the excavator 25 are operated to tilt the bucket 30 into a position as shown in FIG. 8 with the tooth 57 held inclined at a large angle relative to the exposed surface of the tongue 56 and the tip 60 resting therein between the kerfs 55. Preferably, the tip includes a removable, generally wedge-shaped wearing cap 69 and is of a predetermined width dependent upon the amount of force that is exertable by the excavator. To gauge the groove in the tongue, the bucket is pulled toward the tractor 29 with the tip plowing through the surface of the tongue to form the longitudinal groove 61 between the kerfs as shown in FIGS. 8 and 9. It is to be noted that, the depth of the groove not only depends upon the amount of force exerted by the excavator, but also depends upon the nature of the earth which is being grooved. Under normal conditions, the tooth cuts the groove in the earth to a depth that is usually greater than the length of the tip with the upper portion of the groove being flared due to the plowing action of the side edges 59.

It is evident that, upon completion of the groove 61, what remains are the two shoulders 63 (FIG. 9), one being between each kerf 55 and the groove. To break loose these shoulders, the bucket 30 is returned to the far end of the groove with the tooth 57 tilted in a second position inclined at a small angle relative to the earth and with the side edges 59 wedged in the groove against the shoulders. While held in this position, the bucket is pulled toward the tractor 29 thereby wedging the tooth further into the groove and forcing the shoulders laterally into the kerfs to break loose from the tongue (see FIGS. 10 and 11). As the grooving and wedging steps are repeated to eventually dig through the frost line, the loose chunks of frozen earth broken from the shoulders are scooped into the bucket and removed from the hole.

Once the initial hole is opened, further excavation through the frozen earth is preferably accomplished by cutting the kerfs 55 at the edge of the hole and breaking loose substantially all of the resulting tongue 56 in a single pass with the bucket (see FIG. 12). In this instance, the tongue is broken loose by driving the tooth 57 into the tongue adjacent the lower ends or bottoms of the kerfs as indicated in FIG. 12 and curling the bucket to pry loose substantially all of the tongue which, as a natural incident of the curling, falls into the bucket for dumping at the side of the trench. As the bucket is curled to break loose the tongue, the saws 50 cut a new pair of kerfs in the frozen earth to form the next tongue to be removed on a subsequent pass with the bucket. Thus, relatively large chunks of frozen earth are removed in a single pass with the bucket when excavating on the edge of the hole thereby greatly increasing the speed and efficiency with which the trench can be dug once the initial hole is opened.

Thus, it is seen that the coaction of the saws 50, in cutting the kerfs 55, and the tooth 57, in grooving the tongue 56 and wedging loose the shoulders 63, unique-

ly enables the excavator **25** itself to be used to dig through the frozen earth **31** to open the initial hole in a rapid and efficient manner. The advantages of using the excavator which incorporates the features of the present invention are readily apparent over previous methods that require the use of additional equipment and manpower such as by means of jack hammers and the like. For instance, the combined use of the saws **50** and the tooth provides a quick and efficient method of opening the initial hole even through very thick frozen earth. Moreover, the size of the hole being opened is easily controlled and this is particularly advantageous to eliminate extra excavation of frozen earth outside of the desired size hole as is often the result when using prior devices that employ excavator buckets which are simply dropped to penetrate into the frozen earth and break loose indiscriminately sized chunks of frozen earth to open the initial hole. Examples of excavators of this latter type are shown in Buisse, U.S. Pat. No. 2,838,856 and Kondracki U.S. Pat. No. 3,307,277.

In accordance with another aspect of the present invention, the tooth **57** is inclined at a substantial angle relative to the teeth **46** to further enable the excavator **25** to be employed advantageously in the excavation of harder materials such as limestone **70** and the like (see FIG. **13**). As shown in FIGS. **2** and **3**, the tooth is located between the end teeth and extends forwardly of the lip **45** generally straight out from the bottom plate **44** so that the tooth is inclined relative to the teeth at an acute included angle *b* of about thirty five degrees. This arrangement permits the excavator **25** to be operated such that the tooth and the teeth do not engage the surface of the limestone simultaneously. Thus, all of the force exerted by the excavator is concentrated across either the tip **60** of the tooth or the tips of the teeth, depending upon the orientation of the bucket, instead of across the full width of the digging edge and thereby greatly facilitates excavation of the limestone.

When digging in the limestone **70**, the saws **50** are taken off the bucket **30** and several passes are made over the surface of the limestone with the bucket **30** being alternated on successive passes between a first position (FIG. **13**) with just the tooth **57** in engagement with the surface and a second position (FIG. **15**) with the end teeth **46** in engagement with the surface. As the bucket is pulled across the surface of the limestone, the tooth or teeth in engagement therewith break loose and remove the stone to form a trench **72** (see FIG. **16**).

More particularly, a narrow channel **71** (FIG. **14**) similar to the groove **61** (FIG. **9**) is first cut in the limestone by the tip **60** as it is pulled toward the tractor **29** with the bucket **30** by the normal actuators while the bucket is held in the first position. As the channel is formed in this manner, the limestone along both sides thereof is laterally fractured thereby enabling a lower concentration of force to be used to further break loose and remove the limestone at least to the width of the bucket.

To further break loose and remove the limestone **70** at the sides of the channel **71**, the bucket **30** is held in the second position (FIG. **15**) with the end teeth **46** in engagement with the surface of the limestone next to each side of the channel. Then the bucket is pulled toward the tractor **29** with the end teeth plowing into the limestone thereby to further break loose and peel out additional limestone to form the trench **72** to the width of the bucket.

It will be appreciated that by alternating the ripper tooth **57** and the end teeth **46** to scrape across the limestone **70** on successive passes with the bucket **30**, the trench **72** will eventually be dug to desired depth in the limestone. This method of digging through the limestone has substantial advantages over previous method in that the desired trench can be dug much more rapidly and efficiently than is possible with prior devices of a similar nature.

While the excavator **25** has been described with the ripper tooth **57** detachably mounted on the lower lip **45** of the bucket **30**, it will be recognized that such an arrangement could be modified by forming the ripper tooth integrally with the lower lip and that such a modification would embody substantially all of the advantages and novel features of the embodiment described in detail. It should also be noted that the bucket **30**, in addition to its special use as provided by the present invention, can also be used as conventional excavator bucket to perform normal excavation and, due to the ripper tooth **57**, the bucket has an added advantage that is of a particular benefit when digging trenches for tile. That is once a tile trench is dug to the desired depth, the tooth **57** can be used to plow a furrow (not shown) in the bottom of the trench and the tile may be laid in the furrow which acts to prevent the tile from moving as the trench is filled. This avoids the need of packing soil around the sides of the tile in order to hold it in place and therefore speeds up the tile laying process.

I claim as my invention:

1. A digging bucket for use with a backhoe and having a bottom wall terminating in a forward lip, a substantially triangular ripping tooth extending forwardly from said lip and generally forming a continuation of the bottom of said bucket, digging teeth located on opposite sides of said ripping tooth and projecting forwardly of said lip a distance substantially less than the distance said ripping tooth projects forwardly from said lip, said digging teeth being inclined downwardly at an acute included angle relative to the underside of said ripper tooth and at an obtuse included angle relative to the underside of said bottom wall.

2. A digging bucket as defined in claim **1** further including a pair of saws fixedly mounted on said bucket and spaced apart a distance approximately equal to the width of the bucket.

3. In a backhoe bucket for use with an excavator having an articulated boom for supporting the bucket and having operating mechanism for moving the boom and the bucket to excavate a hole in frozen earth and the like, the combination of, a pair of saws fixedly mounted on said bucket in two planes spaced apart a distance approximately equal to the width of the bucket, said saws having rows of cutting teeth and being positioned on said bucket for sawing engagement with the earth during back and forth movement of the bucket by said operating mechanism thereby to cut spaced kerfs through the frozen earth preparatory to excavation, a generally triangular ripper tooth positioned on and substantially spanning the lower lip of the bucket between the side panels thereof and extending forwardly of said lip, said tooth including two side edges converging

toward one another forwardly of the lip, and a tip on the forward ends of the side edges for ripping a groove in the earth between said kerfs as the bucket is held in a first pass position and drawn across the surface of the earth by said operating mechanism thereby forming a frozen shoulder of earth between each kerf and the groove preparatory to a second pass over the groove with said operating mechanism holding the bucket in a second pass position with the side edges of the tooth laterally wedging in the groove against the shoulders to break loose chunks of frozen earth for subsequent removal.

4. The combination as defined in claim 3 wherein said saws are fastened on said bucket by a plurality of bolts extending through holes in the side panels of the bucket, an upstanding member adjacent each of said side panels and attached to the rearward end of said tooth, said members having openings therein aligned with said holes and receiving said bolts to hold said tooth on the bucket.

5. The combination as defined in claim 4 further including an L-shaped hook element interengaging said lip to transmit force between the tooth and the bottom of the bucket and coacting with said bolts to hold the tooth in a fixed position on said bucket.

6. The combination defined in claim 3 wherein said bucket includes a row of digging teeth positioned on the lower lip of the bucket and extending forwardly thereof a predetermined distance, and said tooth fits within the bucket between the side panels thereof and above said digging teeth with the side edges extending forwardly of said lip a distance greater than said predetermined distance, and said tooth includes a stud extending between the bottom surface of said tooth and the top of at least one of said digging teeth to support the forward end portion of said tooth.

7. In a backhoe bucket for use with an excavator having an articulated boom and having operating mechanism for moving the boom and the bucket to excavate a hole in frozen earth and the like, the combination of, a pair of saws positioned along the outer sides of the side panels of the bucket and located for sawing engagement with the earth during back and forth movement of the bucket by said operating mechanism thereby to cut spaced kerfs through the frozen earth, and a generally triangular ripping tooth extending forwardly from and substantially spanning the lower lip of the bucket for gouging out chunks of earth between said kerfs.

8. The combination defined in claim 7 further including mounting members upstanding from the rear portion of said tooth and lying along the inner sides of said side panels, aligned openings formed in said mounting members, said side panels and said saws, and bolts extending through said openings for detachably connecting said tooth and said saws to said bucket.

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