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Cobb

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[54] **IMPACT MATERIAL FRACTURING DEVICE FOR EXCAVATORS AND THE LIKE**

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Related U.S. Application Data

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[52] **U.S. Cl.** **299/70**; 173/43; 173/94; 299/37

[51] **Int. Cl.²** **E21C 27/28**

[58] **Field of Search** ..... 299/14, 37, 67, 69, 70; 37/141 R, 141 T, DIG. 18; 172/40; 173/43, 94, 122, 123

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Primary Examiner—Ernest R. Purser
Attorney, Agent, or Firm—Phillips, Moore, Weissenberger Lempio & Strabala

[57] **ABSTRACT**

There is disclosed an impact material fracturing apparatus that is operated by a dynamic mechanical system designed to deliver large amounts of power in a compact system. The apparatus provides a compact system by arranging the drive shaft and fracturing shank in a substantially parallel arrangement in the same plane. The compact arrangement permits the apparatus to be mounted on a swivel joint for 360° of rotation on its mounting so that when mounted on the end of an excavator boom the apparatus has almost unlimited maneuverability.

20 Claims, 4 Drawing Figures

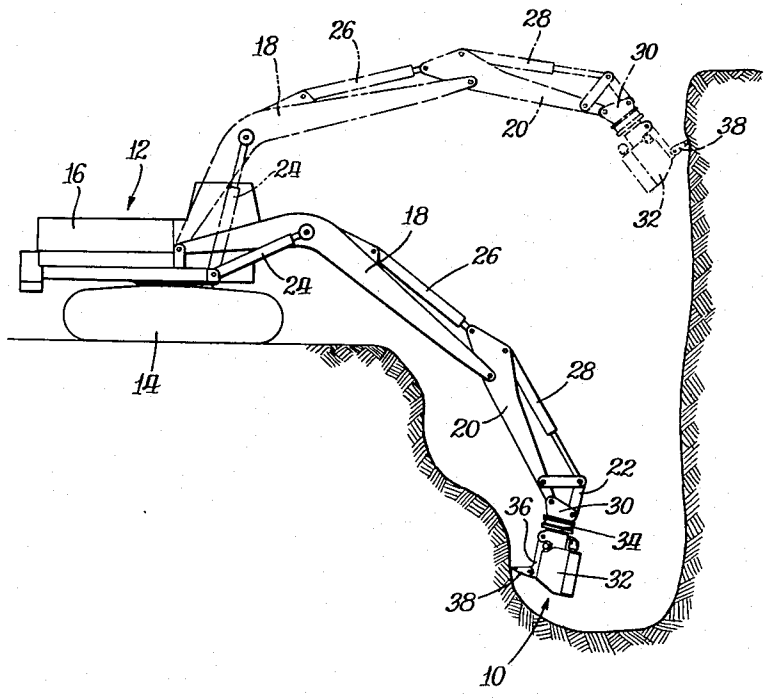


Fig. 1

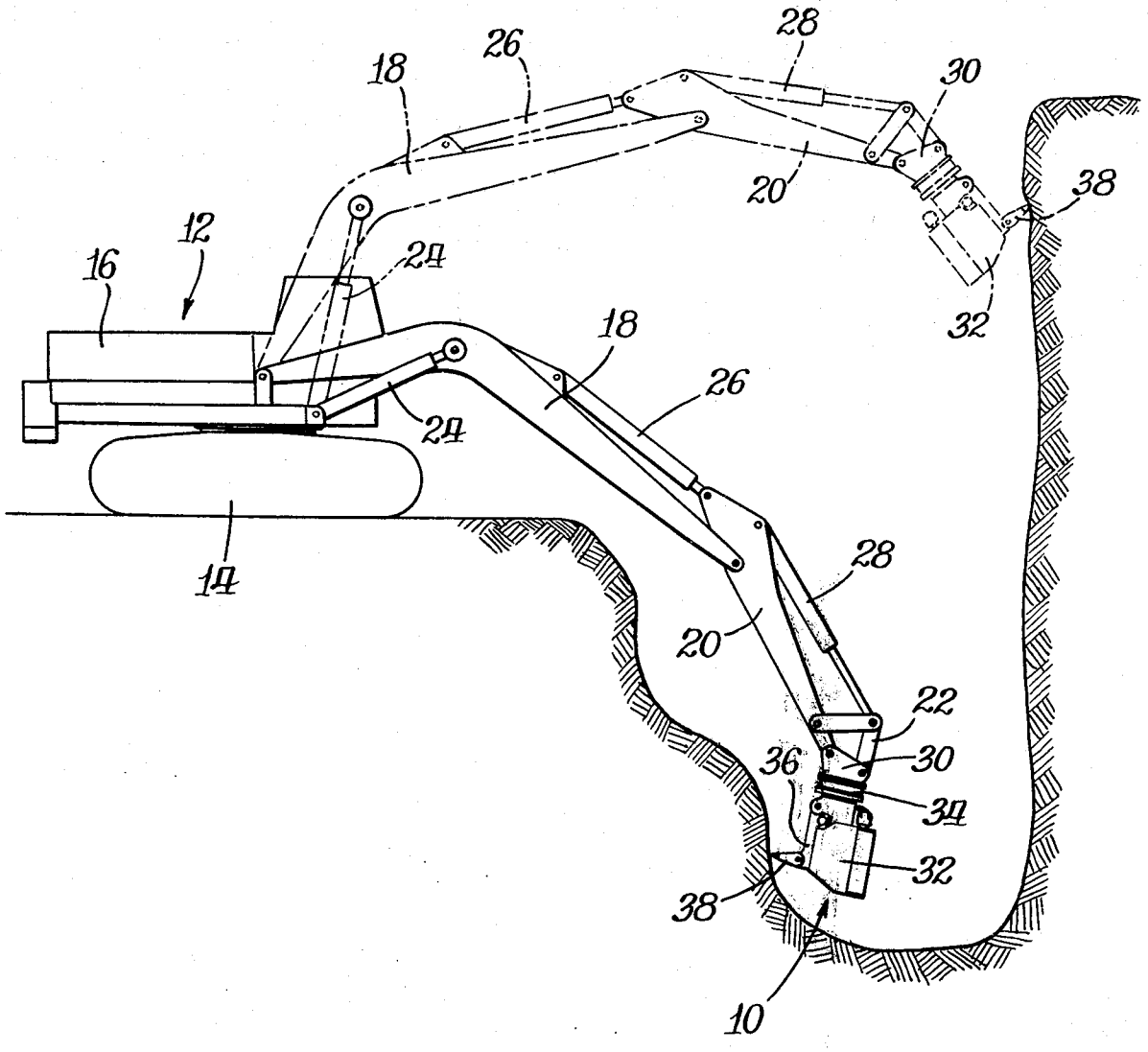


Fig-2-

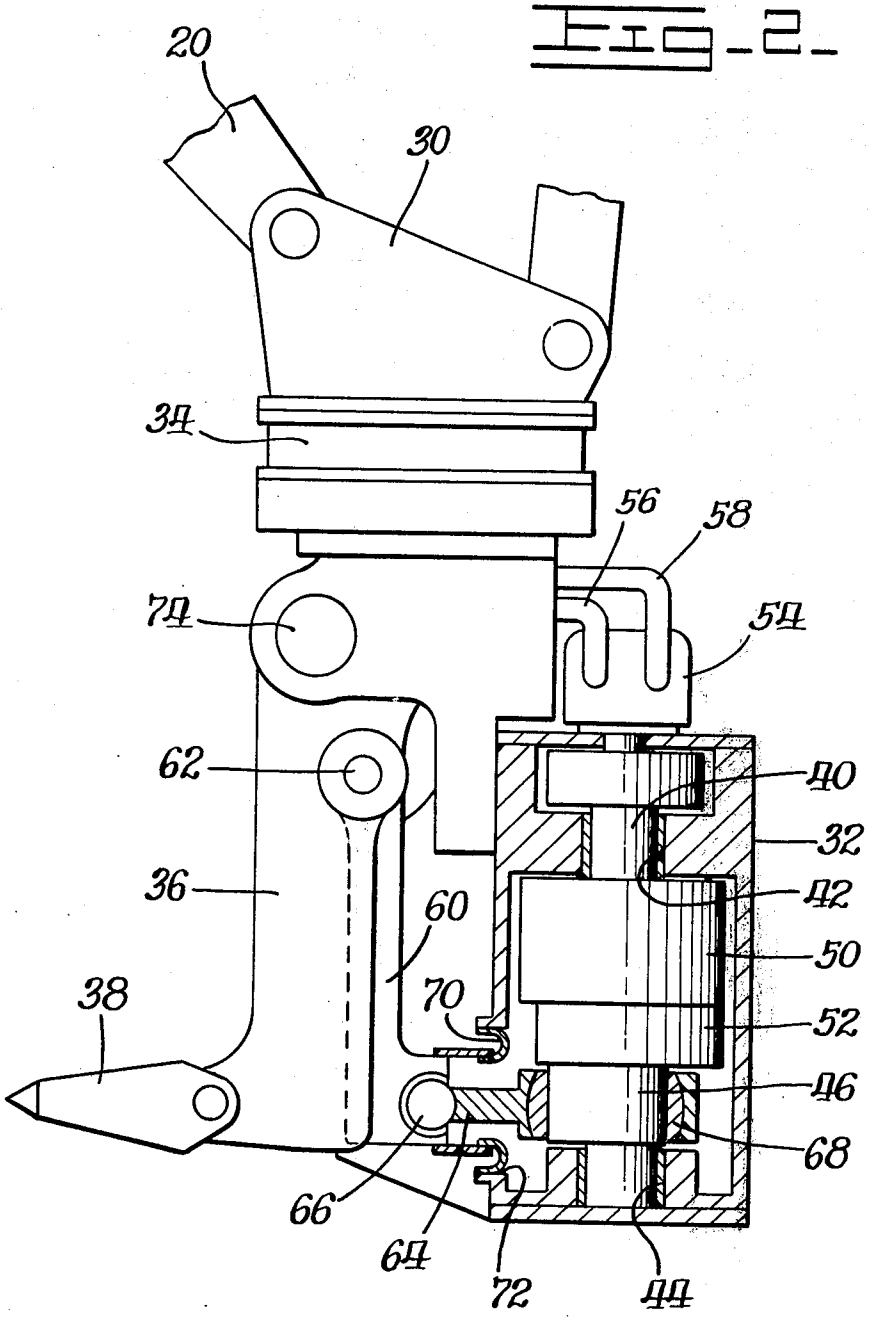


Fig. 3.

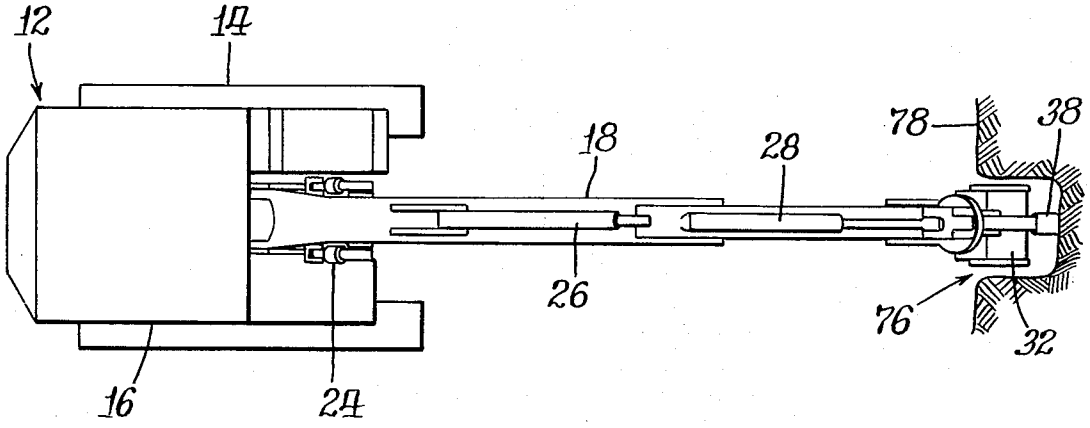
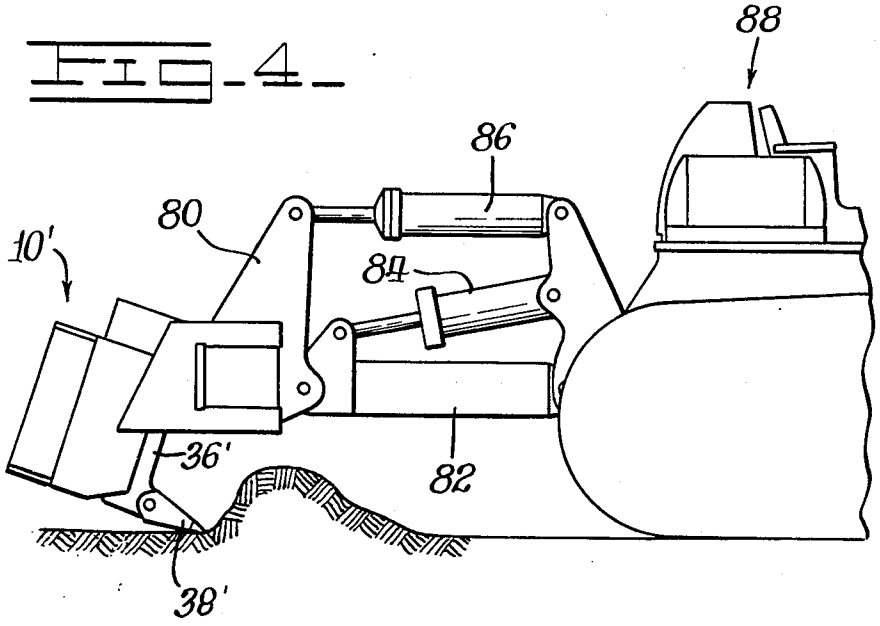


Fig. 4.



IMPACT MATERIAL FRACTURING DEVICE FOR EXCAVATORS AND THE LIKE

This is a continuation of Ser. No. 390,912, filed Aug. 23, 1973.

BACKGROUND OF THE INVENTION

The present invention is directed to rock fracturing implements and pertains more particularly to mechanically powered impace implements for rock breaking and the like.

Numerous devices are available for breaking hard rock and other hard earth formations. These devices now may employ an impact device and a chisel-like tool with impact applied to the tool. Numerous approaches to powering the impact device are available. The most common being the pneumatically driven jack hammer. Others are hydraulically driven and some proposals for mechanical drive have been made.

The prior art is exemplified by the following U.S. Pat. Nos. 3,292,778 issued Dec. 27, 1966 to McAuliff; No. 3,645,021 issued Feb. 29, 1972 to Sonerud; No. 3,677,604 issued July 18, 1972 to Leyrat; and No. 3,743,033 issued July 3, 1973 to Taylor.

These various approaches to the problem of powering the impact device for rock breaking implements have various advantages and disadvantages. Among the disadvantages of the known approaches to this problem are the fact that such means to provide sufficient power to be effective require bulky, complex machinery. Such devices are generally unsuited for close and remote work, that is, remotely positioned from the main power apparatus and in a closely confined work area.

One recently developed approach to powering such apparatus has been the direct coupled mechanically-driven impact hammer, as disclosed in our co-pending application Ser. No. 133,262, filed Apr. 12, 1971, and issued Nov. 6, 1973 as U.S. Patent 3,770,322. The major disadvantage of this approach, however, is that although the apparatus is capable of developing very high powers, it is generally bulky and unsuited for close quarters.

SUMMARY AND OBJECTS OF THE INVENTION

It is a primary object of the present invention to overcome the above problems of the prior art.

Another object of the present invention is to provide mechanically-driven impact-type rock breaking tools that are compact and efficient.

A further object of the present invention is to provide powerful and compact apparatus and power means therefor that is operative or suitable for use in remote positions and in a confined location.

In accordance with the primary aspect of the present invention, there is provided a slim profile mechanically-driven impact apparatus for a rock-breaking tool and suitably mounted for position and use in remote locations. In accordance with the present invention, there is provided an apparatus wherein the driving shaft and apparatus together with the ripping shank is disposed in a single plane and in parallel relationship with suitable pivotable connecting means to permit 360° rotation of the implement with respect to its mounting.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects of the present invention will become apparent from the following description

when read in conjunction with the accompanying drawings:

FIG. **1** illustrates a preferred embodiment of the present invention mounted on the boom of a hydraulic excavator;

FIG. **2** is an elevational view partially in section of a preferred embodiment of the present invention;

FIG. **3** is a plan view of the arrangement of FIG. **1**; and

FIG. **4** is an embodiment of the invention mounted as a ripper on a track-type tractor.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawings and particularly to FIG. **1**, there is illustrated an impact fracturing apparatus in accordance with the present invention shown in combination with a hydraulic excavator. The impact fracturing apparatus generally designated by the numeral **10** is mounted on the outer end of the linkage of an excavator generally designated by the numeral **12.** The excavator is the usual type comprising an undercarriage **14,** a rotatable upper structure **16** that is rotatable around the vertical axis through the undercarriage. The upper structure has connected thereto the usual bucket linkage assembly generally comprising a boom **18,** a stick **20,** and the usual bucket tilt linkage **22** at the outer end of the stick. These linkages are manipulated in a known manner by suitable hydraulically-powered jacks or motors **24, 26, 28** respectively.

The impact fracturing apparatus **10** is designed to be fitted to the linkage when the bucket is removed and comprises generally a base member **30** to which is rotatably mounted a housing **32** containing the internal structure of the apparatus to be described. The housing **32** is secured by means of a swivel joint arrangement **34** including hydraulic driving means for rotating the housing portion **32,** preferably 360° about its axis with respect to the base member **30.**

This combination of the impact fracturing apparatus in combination with the excavator and its linkage provides an extremely versatile machine which may be used in a number of situations such as illustrated wherein it is impossible to reach by other machines. The compact and slim profile arrangement of the impact fracturing apparatus itself permits the apparatus to develop and introduce very high rates of energy into remote and close quarters. The pivotal support of the linkage as well as the rotatable swivel arrangement **34** permits the manipulation of the impact apparatus to very hard to get situations for excavating and for demolishing work. As shown in phantom in FIG. **1,** the linkage may be used to present the apparatus as shown in the uppermost position to work against the face of a wall or cliff as shown.

The internal mechanism of the rock fracturing apparatus develops and delivers high levels of energy to a fracturing shank **36** pivotally secured or mounted to the housing **32** and includes a fracturing tip or point **38** for engaging and fracturing rock and like materials.

Referring now more specifically to FIG. **2,** there is illustrated in detail the apparatus for developing and delivering the energy to the ripper shank **36.** The impact fracturing apparatus as generally shown in FIG. **2** comprises a housing **32** in which is rotatably journalled an eccentric drive shaft **40** rotatably journalled at spaced journals **42** and **44** and comprising an eccentric crank or journal **46.** The drive shaft **40** has appropri-

ately secured thereto suitable massive fly-wheel means comprising in this illustrated embodiment a plurality of fly wheels **50** and **52.** These fly wheels define a generally massive fly wheel system that is balanced in general and may comprise means for counter-balancing the eccentric throw or journal **46.**

This massive balanced fly-wheel system is appropriately driven by a suitable motor such as, for example, a hydraulic motor **54** which is appropriately supplied with hydraulic fluid or the like from suitable conduits **56, 58** which communicate pressurized fluid from a suitable source not shown such as, for example, the hydraulic system of the hydraulic excavator. This drive system permits the system to be remotely driven, or driven from a remote source without complicated shafts and linkage systems. It further provides a compact drive system suitable for the present embodiment.

The energy developed by motor **54** and stored in the massive fly-wheel system carried by drive shaft **40** is delivered intermitently on demand to the ripper shank **36** by means of an impact means comprising, in the illustrated embodiment, an impact member or hammer **60** which is pivotally supported at **62** to the back of the shank **36** and is connected by suitable rigid link member **64** to the eccentric journal **46** of the shaft **40.** The connection of the link **64** to hammer member **60** or impact member **60** is by means of a suitable ball joint **66** and the connection thereof to the eccentric **46** is by a suitable self-aligning bearing means **68.** The self-aligning bearing permits the oscillation of the shank **36** with respect to the drive shaft **40** disposed parallel thereto in the same plane. A suitable seal means such as a boot **70** may be utilized to seal an opening **72** around link member **64** which permits the link to be extended from the inside of housing **32** to the outside thereof. The fracturing shank **36** is pivotally supported such as at a pivot pin **74** in housing **32.**

A compact arrangement of the impact apparatus is achieved by the specific arrangement wherein the eccentric shaft **40** is disposed generally parallel to the ripping shank **36** and substantially in the plane of oscillation of the shank. Moreover, the shank **36** and the shaft **40** are disclosed on generally opposite sides of the pivot axis or rotary axis of the swivel **34.** The rotary axis of the shaft **40** and the shank **36** and the pivot rotary joint also lie in substantially the same plane. This provides a very compact arrangement permitting the close work described herein. This compact arrangement as best seen in the plan view of FIG. **3** permits the cutting of very narrow trenches such as illustrated at **76** in the face of a rock or other similar hard formation **78.**

The impact fracturing apparatus of the present invention is suitable for other types of mountings and suitable applications. For example, with reference to FIG. **4,** there is illustrated a modification wherein the apparatus generally designated by the numeral **10'** is supported by suitable base or support member **80** which is secured by suitable linkage means including a linked member **82** and suitable hydraulic jacks **84** and **86** from a suitable tractor such as a track type tractor generally indicated at **88.** The linkage and support system for the apparatus is preferably such as to enable one to adjust the depth as well as the angle of attack of the shank or cutting point **39'** itself. The apparatus may be used singularly or in a plurality arrangement behind a tractor to improve or increase productivity.

While the present invention has been described with respect to specific embodiments, it is to be understood that numerous changes and modifications may be made therein without departing from the spirit and scope of the present invention as defined in the appended claims.

What is claimed is:

1. A slim profile mechanically driven impact fracturing apparatus, said apparatus comprising:

a housing member;

an elongated fracturing shank pivotally-mounted at one end to said housing member for oscillatory movement about said pivotal mounting and including a fracturing tip at the other end;

a drive shaft rotatably mounted to said housing member and extending substantially parallel to said shank and in the plane of oscillation thereof;

a motor secured to said housing member and connected to said drive shaft;

an eccentric journal mounted on said drive shaft for rotation therewith;

an impact member supported by said housing member for impact engagement with said shank; and,

a rigid link journalled at one end to said eccentric journal and pivotally connected at the other end to said impact member.

2. The apparatus of claim **1** wherein said journal of said link to said eccentric includes a self-aligning bearing.

3. The apparatus of claim **1** wherein said fracturing tip extends at substantially right angles to said pivotal axis.

4. The apparatus of claim **1** wherein said housing member is rotatably mounted to a movable frame for 360° of rotation with respect thereto.

5. The apparatus of claim **4** wherein said 360° of rotation is about an axis substantially parallel to said drive shaft and in said plane of oscillation; and,

said apparatus includes means to rotate said housing member with respect to said movable frame.

6. The apparatus of claim **5** wherein said axis is disposed between said shaft and said shank.

7. The apparatus of claim **6** wherein said apparatus is mounted on the outer end of an extensible boom.

8. The apparatus of claim **6** wherein said apparatus is supported by said movable frame for at least 180° of pivotal movement about a horizontal axis.

9. The apparatus of claim **1** wherein said drive shaft includes a massive flywheel for storing inertial energy.

10. The apparatus of claim **9** including hydraulic motor operatively connected to a said drive shaft to power said apparatus.

11. The apparatus of claim **7** wherein said extensible boom comprises the linkage of a hydraulic excavator, including a boom, a stick, and bucket tilt linkage; and,

said movable frame is pivotally connected to the outer end of said stick and to said bucket tilt linkage.

12. An impact rock fracturing machine comprising in combination:

an excavator machine comprising a mobile undercarriage, a rotatable upper structure mounted for 360° rotation about a vertical axis on said undercarriage, a boom pivoted at one end to said upper structure for pivotal movement in a vertical plane with respect to said upper structure, a stick pivotally connected at one end to the outer end of said boom and including bucket pivot connecting means and tilt linkage at its outer end, and a hydraulic jack for each of said boom, stick, and tilt linkage for pivot

of movement of each about its respective pivot point;

an impact fracturing tool including a housing pivotally mounted on the outer end of said stick at the bucket pivot means and connected to said bucket tilt linkage for pivotal movement about a first axis with respect to said stick so that said tool can be extended outward away from said undercarriage and upper structure by extension of said linkage; and

said housing supporting said impact fracturing tool and mounted for complete 360° rotation with respect to said stick about a second axis which extends at substantially right angles to said first axis.

13. The machine of claim **12** wherein said fracturing tool includes a fracturing shank mounted in said housing for movement at right angles to said second axis and including a point extending away from said axis;

impact means disposed adjacent said shank for intermittently impacting said shank;

a shaft rotatably mounted in said housing parallel to said second axis and including an eccentric throw; and,

means establishing a positive connection of said eccentric throw to said impact means to positively drive same.

14. An impact rock fracturing machine comprising in combination:

an excavator machine comprising a mobile undercarriage, a rotatable upper structure mounted on said undercarriage, a boom pivoted at one end to said upper structure, a stick pivotally connected to the other end of said boom and including bucket pivot connecting means and tilt linkage;

an impact fracturing tool including a housing pivotally mounted on said stick at the bucket pivot means and connected to said bucket tilt linkage for pivotal movement about a first axis with respect to said stick;

said housing supporting said impact fracturing tool and mounted for complete rotation with respect to said boom about a second axis which extends at substantially right angles to said first axis;

said fracturing tool includes a fracturing shank pivotally mounted in said housing for movement at right angles to said second axis and including a point extending away from said axis;

impact means disposed adjacent and pivotally mounted to said shank for intermittently impacting said shank;

a shaft rotatably mounted in said housing parallel to said second axis and including an eccentric throw; and

connecting means comprising a rigid link member pivotally connected at one end to said impact means and journaled at the other end to said eccentric throw.

15. A mechanically driven impact fracturing apparatus, said apparatus comprising:

a housing;

an elongated fracturing shank pivotally mounted at one end to said housing member for oscillatory movement about said pivotal mounting and including a fracturing tip at the other end;

a drive shaft rotatably mounted in said housing and extending substantially parallel to said shank and in the plane of oscillation thereof;

said drive shaft including an eccentric journal for rotation therewith; and

an impact member supported in said housing for impact engagement with said shank, and including substantially rigid means journaled to said eccentric journal for establishing a positive connection of said impact member to said eccentric journal.

16. The impact fracturing apparatus of claim **15** comprising:

a rotary hydraulic motor mounted on said housing for rotating said drive shaft.

17. The impact fracturing apparatus of claim **15** comprising a massive flywheel mounted on said drive shaft and rotatable therewith for storing massive amounts of inertial energy.

18. The impact fracturing apparatus of claim **15** comprising mounting means for mounting said housing for at least limited angular adjustment about an axis extending parallel to the axis of said drive shaft.

19. The impact fracturing apparatus of claim **17** comprising mounting means for mounting said housing for at least limited angular adjustment about an axis extending parallel to the axis of said drive shaft.

20. The impact fracturing apparatus of claim **19** comprising:

a rotary hydraulic motor mounted on said housing for rotating said drive shaft.

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