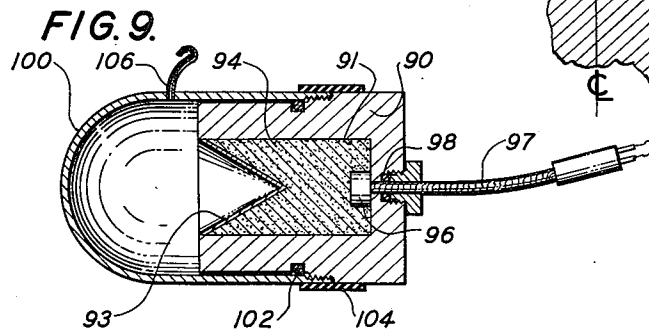
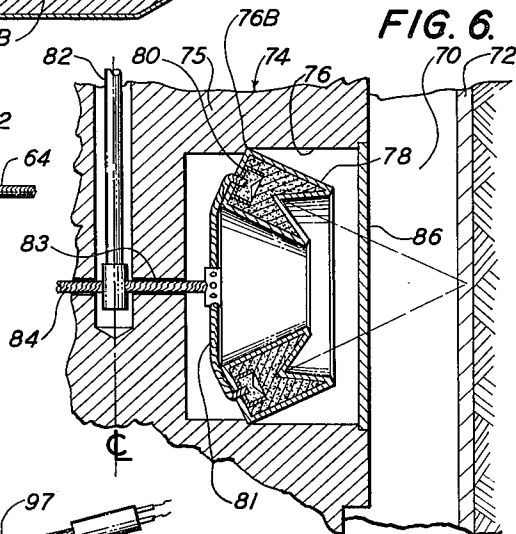
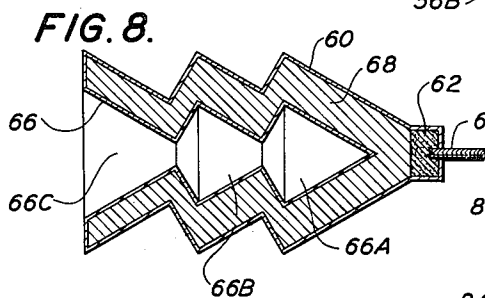
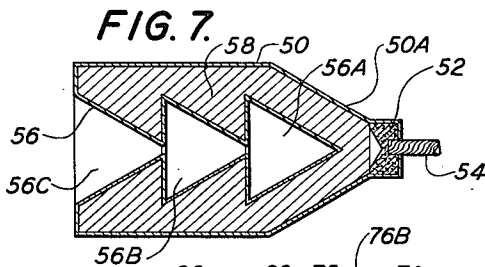
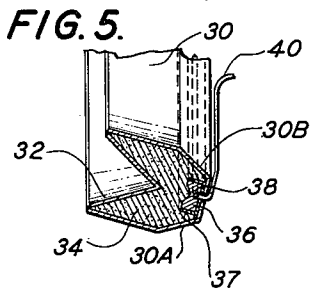
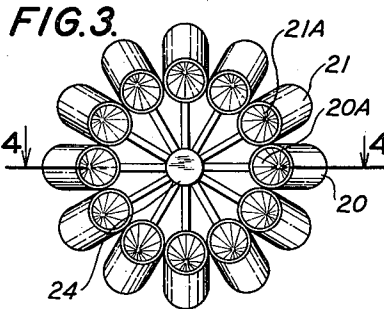
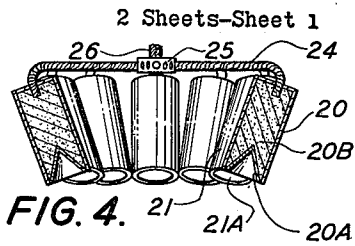
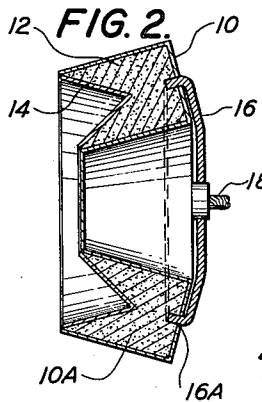
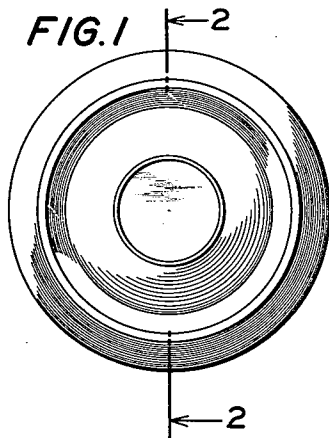


May 16, 1961

C. H. BARNES
CUTTING APPARATUS

2,984,307

Original Filed Oct. 6, 1952



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2 Sheets-Sheet 2

FIG. 10.

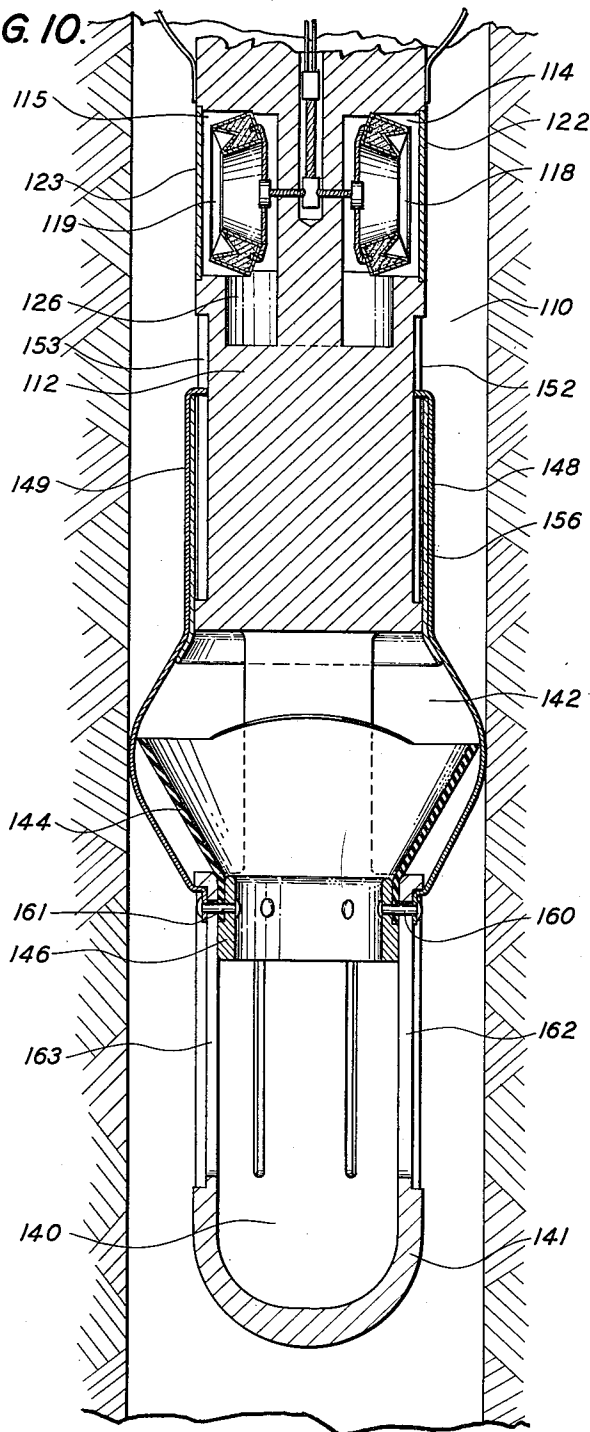


FIG. 12.

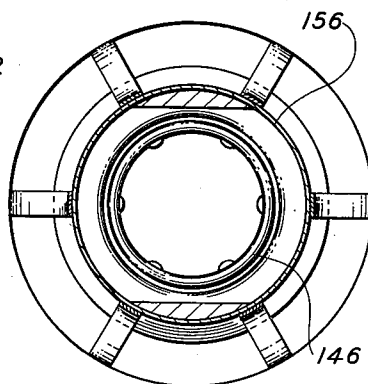
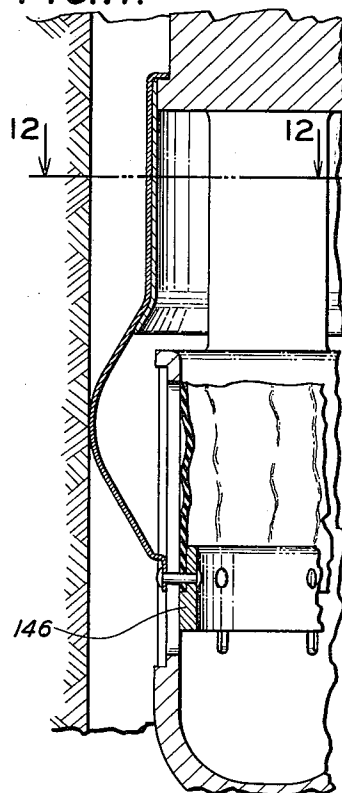


FIG. 11.



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2,984,307

CUTTING APPARATUS

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Continuation of application Ser. No. 313,324, Oct. 6, 1952. This application Sept. 27, 1957, Ser. No. 687,339

18 Claims. (Cl. 175-2)

This invention relates to shaped charges and particularly to means and methods of compounding the effectiveness and utility thereof.

This application is a continuation of the applicant's pending application Serial No. 313,324, now abandoned, filed October 6, 1952, for "Cutting Apparatus."

It has long been known that if an explosive charge is detonated on a metal surface, an outline of the charge will be engraved in the metal. This phenomenon is brought about by the action of concentrated shock waves on the metal surface. It has also been found that if a small cavity is formed in the explosive charge and particularly if the cavity is of conical configuration and opening toward the metal surface, the effect of the explosion on the metal will be magnified. The explanation is advanced that this cavity brings about a greater concentration of shock waves prior to impingement on the metal, resulting in an appreciable velocity increase and a consequent greater effectiveness.

This principle is found practical to use in oil well casing perforators wherein an explosive pellet having a conical cavity in its base is positioned adjacent a wall of the casing with the cavity opening toward the casing. On detonation such a pellet will blow a hole through the casing. Shaped charges are also employed in ordnance projectiles wherein the attainable shock wave concentration gives greater armor piercing properties.

I have now discovered that the jet effect of a shaped charge can be increased in a magnitude over and above any increase in explosive weight either by elimination of interference in the region of shock wave convergence or by the multiplied simultaneous or tandem convergence of shock waves. The latter expedient consists in essence of developing a resultant wave as originating from a shaped charge mass and converging such wave with one or more similar waves developed by another shaped charge mass.

The invention in one aspect contemplates a plurality of shaped charges or shaped charge masses which may be either discretely or conjointly housed and each of which is adapted to develop within itself convergent shock waves and so arranged that the consequent plurality of convergent shock waves converge to form a resultant shock wave of multiplied force. In another aspect the invention contemplates reduction of ambient impedance to the formation of a convergent shock wave jet from a shaped charge by removal from the region of convergence and development of such a shock wave interfering substance of either gaseous or liquid nature. The term "fluid" is used hereinafter as generic to both gases and liquids in this respect.

I have found that even the presence of air in the region between shock wave origin and convergence impairs the effectiveness of the jet formed at the point of convergence. These two approaches to the objective of increasing the effectiveness of shaped charges are interrelated not only in that they may be used conjunctively but further that they have much the same end effect, namely the increase in intensity of a jet developed by a

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given quantity of explosive by removing or overcoming at least a part of the inherent impedance to the formation of such a jet.

The invention has much practical utility apart from the feature of increased effectiveness. Thus, means are provided, as will be explained in greater detail in conjunction with the drawing, for causing convergent jets to accomplish useful work in the process of convergence. Also, by arranging convergently directed shaped charge masses so that jet convergence is effectuated prior to encountering any appreciable impedance, a resultant jet of tremendously increased effectiveness and having a correspondingly greater penetrating power is developed.

The invention will be more clearly understood with reference to the following detailed description thereof as taken in conjunction with the accompanying drawing in which:

Fig. 1 is a front elevation of one preferred form of compounded shaped charge in accordance with the invention;

Fig. 2 is a sectional elevation taken on the line 2-2 of Fig. 1;

Fig. 3 is a front elevation of another form of multiple charge in accordance with the invention;

Fig. 4 is a transverse section taken on the line 4-4 of Fig. 3;

Fig. 5 is a transverse section through a modified form of the shaped charge configuration of Fig. 1;

Fig. 6 is a sectional elevation through a portion of a well bore showing in sectional elevation means for employing apparatus similar to that illustrated in Fig. 1 as a casing perforator;

Fig. 7 is a longitudinal section through another form of compounded shaped charge;

Fig. 8 is a longitudinal section through a modification of the apparatus of Fig. 7;

Fig. 9 is a longitudinal section through one form of apparatus adapted to reduce impedance to jet formation;

Fig. 10 is a sectional elevation through a portion of a well bore and apparatus disposed therein in accordance with the invention for obtaining mineral samples of the bore defining strata;

Fig. 11 is a partial sectional elevation showing the apparatus of Fig. 10 as it appears after such a sample is secured; and

Fig. 12 is a horizontal section taken on the line 12-12 of Fig. 11.

Referring to Figs. 1 and 2, the apparatus there shown comprises a housing 10 defining an annulus 10A in which is disposed a quantity of explosive 12 retained in the housing by an annular liner 14 of triangular cross-section. The housing is open at the end disclosed by the liner 14 and is convergent towards the axis of symmetry thereof so that a plurality of lines projected along the longitudinal axis of spaced cross-sections of the housing will intersect the apex of the liner and will converge at a point spaced from the open end of the housing. The outer and inner mutually parallel walls of the housing in effect define concentric frusto-conical sections. A detonator 16 in the form of a cup-shaped disk is mounted symmetrically with respect to the housing axis with a peripheral lip 16A of the disk extending through the rear wall of the housing 10 into the annular explosive body. The detonator or booster charge 16 may in composition be conventional and in this instance is unique in the disk-shape which insures simultaneous circumferential detonation of the explosive in the annulus 10A. The booster 16 is detonated by a conventional explosive cord 18 and in conventional manner.

The integral annularly shaped charge 12 may be considered as a plurality (approaching infinity) of separate contiguous charges. When the explosive charge 12 is

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detonated in the apparatus illustrated in Figs. 1 and 2, each cross-sectional explosive mass develops convergent shock waves, the angle of convergence being determined by the triangular sectioned liner 14 with the resultant waves being directed along the line bisecting the liner. Because of the frusto-conical shape of the annular chamber the totality of shock waves developed by the charge 12 will in turn converge on or approximately on the longitudinal axis of the annular chamber so that in effect what is accomplished is a shaped charge upon a shaped charge. The resultant jet formed on the longitudinal axis of the chamber has a greater velocity and penetrating power than is obtainable from a conventional cylindrical shaped charge containing the same amount of explosive.

The apparatus shown in front elevation and in transverse sectional elevation, respectively, in Figs. 3 and 4 is similar in principle to the apparatus of Figs. 1 and 2, differing therefrom in that a plurality of separate cylindrical shaped charges 20, 21, 22, etc. are arranged to define a frusto-conical envelope with each charge having an inverted conical liner 20A, 21A, etc. retaining an explosive charge 20B, etc. therein, the liners comprising closure members on the inwardly directed ends of the several cylinders 20, 21, etc. Again the objective is to detonate the several explosive masses simultaneously, and in this case accomplished by a booster spider 24 having one leg extending from a central junction to each of the cylinders 20, 21, etc. and connected to an explosive cord 26 at central junction 25.

The arrangement of Figs. 3 and 4 differs from the apparatus of Figs. 1 and 2 in that the plurality of convergently directed charges are discrete rather than contiguously associated.

Each of the individual shaped charges 20, 21, etc. of this system develops a jet comprising shock waves converging on the axis of symmetry of the respective conical liner, and the several jets thus developed converge on the longitudinal axis of symmetry of the envelope defined by the several separate charges.

Fig. 5 is a transverse section through a portion of a shaped charge similar to that of Figs. 1 and 2, differing therefrom in the cross-sectional configuration of the explosive housing and in the means provided for detonation of the enclosed charge. Housing 30 in Fig. 5 is provided with a front liner 32 of triangular section and with a body of explosive 34 retained within the annulus defined by the housing and liner. The housing 30 differs in cross-sectional configuration from that of housing 10 in Fig. 2 by the existence of converging segments 30A, 30B adjacent the annular end face of the chamber opposite the liner 32. I have found that this shape reduces explosive requirements without any reduction and, in fact, with an attendant increase in force development and particularly when these convergent surfaces lie approximately parallel to the corresponding liner wall.

The means for detonating explosive charge 34 in the embodiment of Fig. 5 comprises an annular detonator or booster charge 36 disposed in the chamber adjacent the rear face thereof and confined in an annular channel member 37. An electric wire 38 circumscribes the channel member 37 and is connected through a suitable lead 40 to a source of electric power (not shown). Substantially simultaneous detonation of the annular explosive charge 34 is obtained in this case by the simultaneous detonation of the annular booster 36 as effectuated by the wire 38, which, upon being supplied with suitable electrical energy, will, throughout its length, reach a detonating temperature at the same instant.

Another feature of the invention illustrated in the embodiment of Fig. 5 is that of providing the detonator charge itself with a shaped exposed surface of approximately triangular cross-section. I have found that a detonator charge of this configuration serves to insure proper propagation through the body of the shaped charge itself with a resultant improvement in jet development.

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Fig. 6 shows in sectional elevation one manner of using apparatus of the type described above. In the figure a portion of a well bore 70 is illustrated, defined by a conventional tubular casing 72. A casing perforator 74 is shown suspended in the well and comprises a carrier 75 having a cavity 76 in its side wall in which an annular shaped charge 78 is disposed conveniently bottomed on an annular shoulder 76B formed in the cavity 76. The shaped charge 78 is similar in configuration to the charge shown in Fig. 2 and in this instance is provided with an annular detonator 80, as in Fig. 5, and an explosive cord spider 81, similar to that shown in Fig. 3. One or a plurality of such charges can be located in the side wall of the body 75, the illustration including an explosive cord 82 having a branch 83 leading to the spider 81 and a second branch 84 adapted for connection to a second explosive charge (not shown). The cavity 76 in which the explosive charge is arranged is enclosed by a face plate 86 for excluding well bore fluids from the region of the charge.

In operation the charge is detonated as above described, the shock waves converging outwardly of the face plate 86 effectively disintegrating this plate in the process and at a point adjacent the casing wall. Convergence can be either inwardly of the casing, within the casing (as illustrated) or outwardly of the casing, depending upon the size hole desired and also upon the energy necessary to accomplish the perforation. Maximum energy is of course achieved if convergence is inwardly of the casing wall.

Fig. 7 is a longitudinal sectional elevation through another form of shaped charge of the invention showing an entirely different means of jet multiplication. This charge comprises a generally cylindrical housing 50 having a frusto-conical rear end 50A with a detonator or booster charge 52 disposed symmetrically about the longitudinal axis of the chamber in the apex of the frusto-conical end. A suitable explosive cord 54 is connected into the detonator chamber 52 to accomplish detonation of the detonator. The detonator in this instance is provided with a shaped exposed surface, as in the apparatus of Fig. 5, and for the purposes discussed with relation thereto. A liner 56 is disclosed in the housing 50 symmetrically about the longitudinal axis thereof and defining three serially arranged conical chambers 56A, 56B, 56C within the housing with each chamber communicating with the succeeding chamber through a comparatively small narrow opening formed at the apex of the succeeding chamber. The region defined between the housing 50 and the liner 56 is filled with an explosive 58 so that each transverse segment of the housing 50 as defined by the respective bases of the serially arranged conical chambers formed by the liner 56 are in the nature of a shaped charge.

Upon detonation of the apparatus of Fig. 7 a separate jet is formed as a consequence of each of the serially arranged conical chambers and the propagation of the explosive wave through the explosive body 58 is such that the first formed jet combines with the second formed jet at the moment of convergence of the shock waves developing the same, and the resultant jet in turn combines with the third formed jet at the point of and at the instance of convergence of the shock waves developing this jet. The ideal situation has been described in which the jets combine at the point of and at the instant of formation of the succeeding jet and under such ideal conditions optimum results are of course achieved. However, even though there is some departure from these optimum conditions a resultant shock wave or jet will be developed which is of greater force than that derivable from the same amount of explosive confined as a single shaped charge.

The embodiment shown in longitudinal section in Fig. 8 is similar to that shown in Fig. 7 and includes a housing 60 having a detonator charge 62 located in one end

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and connected to an explosive cord 64 and having a liner 66 disposed therein and arranged symmetrically about the longitudinal axis of the housing. In this embodiment the liner again defines three chambers 66A, 66B, 66C within the housing, each of the inner chambers in this case comprising a first substantially conical section and a second adjoining inverted conical section with the inverted conical section leading into the apex of the conical section of the succeeding chamber and with the several chambers communicating with each other adjacent their respective apexes. Also the housing 60 is in the form of a series of frusto-conical sections with succeeding sections being joined by inverted frusto-conical sections, the result being that the housing walls are substantially parallel to the liner wall. An explosive charge 68 is confined in the annular region defined by the housing 60 and the liner 66. Upon detonation a multiplied shock wave or jet is developed in the manner described with relation to the embodiment of Fig. 7. The configuration of the embodiment of Fig. 8 is such as to minimize the amount of explosive employed and to insure approximately optimum alignment both from a spatial and time standpoint of the serially developed shock waves.

Fig. 9 shows in longitudinal section one means of increasing the effectiveness of the shaped charge in accordance with the invention and comprises a charge housing 90 having a cylindrical cavity 91 opening towards one end and provided at the end with a conical liner 93. An explosive charge 94 is disposed in the housing and is defined in configuration by the cylindrical cavity and the liner 93. A detonator 96 and an explosive cord 97 provide means for detonating the charge, the cord 97 being carried through a ring gasket 98. A domed envelope 100 is sealed over an end of the housing, sealing at a ring gasket 102, and a sleeve 104. After the charge is loaded the envelope 100 is evacuated as through the conduit 106 so that the area of convergence of the shock waves of the charge is under vacuum, the higher the degree of vacuum the greater the effectiveness of the apparatus.

Another method of using a charge of the type shown in Figs. 1 and 2 is illustrated in various aspects in Figs. 10, 11 and 12. The apparatus there shown in suspended in a well bore 110, the apparatus comprising a carrier body 112 having one or more cavities 114, 115 in a side wall containing annular shaped charges 118, 119 respectively and being enclosed by face plates 122 and 123 respectively. This portion of the apparatus is similar to the apparatus shown in Fig. 6, the difference being that the annular charges are arranged so that the shock waves are directed to converge at a point outwardly of the wall of the well bore.

Immediately below the cavities referred to and inwardly of the side wall of the body is an annular cavity 126. Below the shaped charges a section 141 of the body forms a pocket 140 to which access is had by an annular opening 142 in the body and which is defined at its upper end by a flexible funnel member 144 mounted to a sleeve 146 in turn slidable in the cavity. Two or more leaf springs 148, 149, etc. are anchored at one end in respective longitudinal slots 152, 153 in the body upwardly of the cavity and engaging over a slidable hood 156. The springs 148, 149 bell outwardly to bear against the walls of the bore hole thereby centering the body in the hole, and are at their lower ends fastened as by rivets 160, 161 respectively to the sleeve 146, the rivets projecting through longitudinal slots 162, 163 respectively in the wall of the body section 141. On firing the shaped charges 118, 119 a conical segment of the adjoining strata is cut by the convergence of the shock waves outwardly of the wall. These samples may be blown inwardly to fall in the cavity 126 or may fall into the annulus between the body and the bore hole wall. In this latter event such a sample will be trapped by the funnel member 144 to fall in the basket 140.

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After obtaining the samples in this manner, and as the body member is lifted from the well bore, friction on the springs 148, 149, etc. causes relative displacement of both the upper and lower ends of the springs downwardly of the body by sliding in the slots 152, 153 and the lower slots 162, 163. In this process the funnel is retracted within the basket and the hood 156 is carried downwardly to overlie the upper opening of the basket, in this manner protecting the trapped sample. The relative position of these various elements after the described displacement of the spring is shown in the partial elevation of Fig. 11.

It will be understood, of course, that the apparatus of Figs. 10, 11 and 12 is not limited to the use of shaped charge arrangements of the kind shown in Figs. 1 and 2 but also may use charges constructed as shown in Figs. 3 and 4.

I claim:

1. Apparatus for taking side-wall formation samples from well boreholes comprising: a body member having a cavity therein, said body member being adapted to be lowered into a borehole, an opening in the side of said body member communicating with the cavity, an explosive shaped-charge having an open-ended annular groove therein, the open end of said groove being directed to form an annular converging sheet of explosive gases when said shaped charge is detonated, means securing said shaped charge in said cavity with the open end of the annular groove of the shaped charge facing outwardly of said opening, said body member being provided with means for receiving and retaining formation samples resulting from the explosion of said shaped charge.

2. Apparatus for taking side-wall samples from fluid-filled well boreholes comprising: a hollow body adapted to be lowered into a borehole and having an opening in the side thereof; an explosive shaped charge means within said body, said means including an explosive charge having an elongated groove-shaped cavity therein adapted when said charge is detonated to form a correspondingly elongated cutting sheet of gases converging on a point and defining a definite volume outside said hollow body; means securing said shaped charge means within said body in position to direct said cutting sheet of gases outward through said opening; and a chamber in said body, located below and in communication with said opening for receiving and retaining formation samples entering said opening.

3. Apparatus for taking side-wall samples from fluid-filled well boreholes comprising: a hollow body adapted to be lowered into a borehole and having an opening in the side thereof; an explosive shaped charge means within said body, said means including an explosive charge having an elongated groove-shaped cavity therein adapted when said charge is detonated, to form a correspondingly elongated cutting sheet of gases of conical form converging on a point and forming a closed surface defining a definite volume outside said hollow body; pressure resistant means for initially excluding borehole fluid from said cavity; means securing said shaped charge means within said body in position to direct said cutting sheet of gases outward through said opening; and a chamber in said body, located below and in communication with said opening for receiving and retaining formation samples entering said opening.

4. Apparatus for taking side-wall samples from fluid-filled well boreholes comprising: a hollow body adapted to be lowered into a borehole and having an opening in the side thereof; frangible means initially closing said opening; an explosive shaped charge means within said body, said means including an explosive charge having an elongated groove-shaped cavity therein adapted when said charge is detonated, to form a correspondingly elongated cutting sheet of gases converging on a point and forming a closed surface defining a formation sample volume outside said hollow body; pressure resistant

means for initially excluding borehole fluid from said cavity; means securing said shaped charge means within said body in position to direct said cutting sheet of gases outward through said opening; and a chamber in said body, located below and in communication with said opening for receiving and retaining formation samples entering said opening.

5. Apparatus for taking side-wall samples from fluid-filled well boreholes comprising: a hollow body adapted to be lowered into a borehole and having an opening in the side thereof; frangible means initially closing said opening; an explosive shaped charge means within said body, said means including an explosive charge having an elongated groove-shaped cavity therein adapted, when said charge is detonated, to form a correspondingly elongated cutting sheet of gases defining a substantially conical sidewall sample, said cutting sheet of gases converging on a point and forming a closed surface defining said sample outside said hollow body; means including said frangible means for securing said shaped charge means within said body in position to direct said cutting sheet of gases outward through said opening; and a chamber in said body, located below and in communication with said opening for receiving and retaining formation samples entering said opening.

6. Apparatus for taking side-wall samples from fluid-filled well boreholes comprising: a hollow body adapted to be lowered into a borehole and having an opening in a side portion thereof; an explosive shaped charge within said body, having an annular groove-shaped cavity therein, adapted when detonated to form an annular shaped, cutting sheet of gases converging to define a closed surface of definite volume outside said hollow body; means securing said shaped charge within said body in position to direct said annular shaped sheet of gases outward through said opening; and retaining means in communication with said opening for receiving and retaining formation samples entering said opening.

7. Apparatus for taking side-wall samples from fluid-filled well boreholes comprising: a hollow body adapted to be lowered into a borehole, and having an opening in the side thereof; an explosive shaped charge within said body having an annular groove-shaped cavity therein, said groove-shaped cavity being directed to form an annular-shaped convergently directed cutting sheet of gases when said shaped charge is detonated; means securing said shaped charge within said body in position to direct said annular-shaped sheet of gases outward through said opening; and retaining means in communication with said opening for receiving and retaining formation samples entering said opening.

8. Apparatus for taking side-wall samples from fluid-filled well boreholes comprising: a hollow body adapted to be lowered into a borehole and having an opening in the side thereof; an explosive shaped charge within said body, having an annular groove-shaped cavity therein, said groove-shaped cavity being directed to form an annular-shaped convergently directed cutting sheet of gases when said shaped charge is detonated, pressure resistant means for initially excluding borehole liquid from said cavity; means securing said shaped charge within said body in position to direct said annular-shaped sheet of gases outward through said opening; and retaining means in communication with said opening for receiving and retaining formation samples entering said opening.

9. In apparatus for taking side-wall samples from fluid-filled well boreholes the combination of: a hollow body adapted to be lowered into a borehole and having an opening in the side thereof; explosive shaped charge means within said body, said means including an explosive charge having an elongated groove-shaped cavity therein adapted when said charge is detonated to form a correspondingly elongated cutting sheet of gases converging in a point and defining a substantially conical sample volume outside said hollow body; means securing

said shaped charge means within said body in position to direct said cutting sheet of gases outwardly through said opening; pressure resistant means for initially excluding borehole fluid from said cavity; and a chamber in said body located below and in communication with said opening for receiving and retaining formation samples entering said opening.

10. Apparatus for securing mineralogical samples comprising: a carrier having a cavity in its outer surface; a plurality of shaped charge means components supported within the cavity and arranged so that the shock waves developed by the several means components converge at a point in space outwardly of the carrier, a displaceable closure member disposed across the cavity enclosing the charge means components therein, means supporting the carrier adjacent a mineral body so that said point in space lies within the mineral body, and means spaced from the cavity adapted to trap and retain mineral samples developed outwardly of the cavity.

11. Apparatus for taking samples from the walls of well boreholes comprising: a carrier, a plurality of explosive shaped charge elements supported in a substantially continuous array by said carrier, each of said elements having a cavity defining an explosive jet axis, said elements being positioned such that the axes thereof define a closed surface having an axis of symmetry extending transversely of the borehole, said elements when detonated developing an explosive jet encompassing a definite volume of the formation surrounding the borehole to dislodge samples therefrom, chamber means carried by said carrier below said shaped charge means having an opening to the borehole adapted to trap and retain said samples, and retractable cover means arranged to cover said opening.

12. Apparatus according to claim 11 including frictional means engaging said well wall adapted to actuate said cover means to uncover the chamber when the carrier is lowered within the borehole and to cover the chamber when the carrier is raised within the borehole.

13. Apparatus for taking samples from the walls of well boreholes comprising: a carrier, a plurality of explosive shaped charge elements supported in a substantially continuous array by said carrier, each of said elements having a cavity defining an explosive jet axis, said elements being positioned such that the axes thereof define a closed surface having an axis of symmetry extending transversely of the borehole, said elements when detonated developing an explosive jet encompassing a definite volume of the formation surrounding the borehole to dislodge samples therefrom, chamber means carried by said carrier below said shaped charge means adapted to trap and retain said samples and retractable funnel means adapted to be flared outwardly from the top of said chamber and to be retracted within said chamber; and cover means movable with said funnel means to overlie the top of said chamber when said funnel means is in the retracted position to protect a sample trapped in said container means.

14. Apparatus according to claim 13 including frictional means engaging said well wall adapted to dispose said funnel means outwardly from the top of said chamber when the carrier is lowered within the borehole and to retract said funnel means within the chamber when the carrier is raised within the borehole.

15. Apparatus for taking samples from the walls of well boreholes: a carrier, a plurality of explosive shaped charge elements supported in a substantially continuous array by said carrier, each of said elements having a cavity defining an explosive jet axis, said elements being positioned such that the axes thereof define a closed surface having an axis of symmetry extending transversely of the borehole, said elements when detonated developing an explosive jet encompassing a definite volume of the formation surrounding the borehole to permit dislodging of a sample from the adjacent borehole wall,

container means carried by said carrier adjacent said shaped charge means for receiving and retaining said sample; and means for supporting said carrier in a borehole.

16. Apparatus for taking samples from the walls of well boreholes comprising: a carrier, a substantially continuous annular shaped charge mass supported by said carrier, said shaped charge mass having an open-ended annular groove therein defining an annular substantially continuous array of explosive jet axes, said shaped charge mass being positioned such that said axes define a closed surface having an axis of symmetry extending transversely of the borehole, said shaped charge mass when detonated developing an explosive jet encompassing a definite volume of the formation surrounding the borehole to permit dislodging of a sample from the adjacent borehole wall, container means carried by said carrier adjacent said shaped charge means for receiving and retaining said sample; and means for supporting said carrier in a borehole.

17. Apparatus for taking samples from the walls of well boreholes comprising: a carrier, a plurality of discrete explosive shaped charge elements supported in a substantially continuous array by said carrier, each of said elements having a cavity defining an explosive jet axis, said elements being positioned such that the axes thereof define a closed surface having an axis of symmetry extending transversely of the borehole, said elements when detonated developing an explosive jet encompassing a definite volume of the formation surrounding the borehole to permit dislodging of a sample from the adjacent borehole wall, container means carried by said carrier adjacent said shaped charge means for receiving and retaining said sample; and means for supporting said carrier in a borehole.

18. Apparatus for taking samples from the walls of well boreholes comprising: a carrier, a plurality of explosive shaped charge elements supported in a substantially continuous array by said carrier, each of said elements having a cavity defining an explosive jet axis, said elements being positioned such that the axes thereof converge in a direction towards the borehole wall and define a closed surface having an axis of symmetry extending transversely of the borehole, said elements when detonated developing an explosive jet which converges towards a region in space outwardly of said carrier; means for supporting said carrier in a borehole adjacent to borehole wall so that said region lies within the formation surrounding the borehole and near the wall thereof and encompasses a definite volume of the formation surrounding the borehole to permit dislodging of a sample from the borehole wall; and container means carried by said carrier adjacent said shaped charge means for receiving and retaining said sample.

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