Jan. 16, 1962 J. H. KIRBY II 3,016,830

JUNK SHOT

Original Filed Nov. 25, 1955

Fig. 1

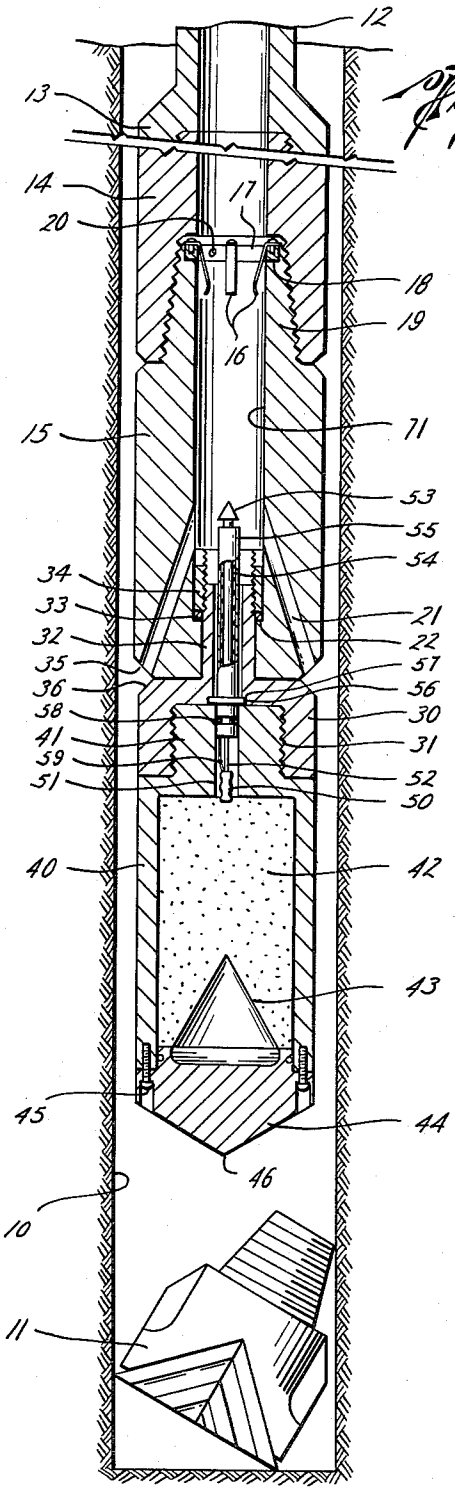
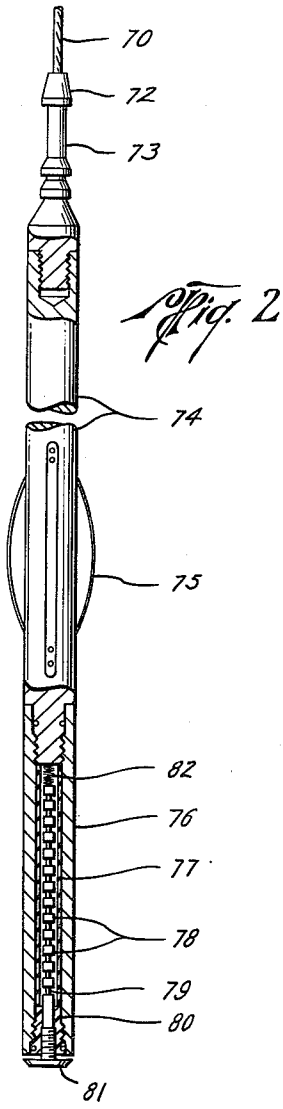


Fig. 2



John Henry Kirby, II
INVENTOR.

BY Murray Robinson

ATTORNEY

United States Patent Office 3,016,830 Patented Jan. 16, 1962

3,016,830

JUNK SHOT

John Henry Kirby II, 2302 Cloquitt, Houston, Tex.

Continuation of application Ser. No. 548,878, Nov. 25, 1955. This application Mar. 4, 1959, Ser. No. 797,093

6 Claims. (Cl. 102—20)

This invention pertains to a device for breaking up material in a well bore that is interfering with the progress of drilling the well, such material being commonly referred to as "junk."

This application is a continuation of my prior application of the same name, Serial Number 548,878, filed November 25, 1955.

The object of the invention is to provide a simple and efficient device for breaking up junk.

A further object of the invention is to provide such a device that can easily be brought into position adjacent the junk where it will be effective to break it up.

According to the invention, an explosive charge is connected to the lower end of a string of pipe, lowered into the well, and with the aid of fluid jets from the lower end of the pipe adjacent the charge the latter is enabled to penetrate through the usual pile of cuttings and detritus at the bottom of the hole until it contacts the junk at the bottom of the hole. The charge is then detonated by means of an electric "go-devil" lowered inside the pipe on a wire line.

A further object of the invention is to protect the jets and detonation means as much as possible from the effect of the explosion of the charge whereby these parts of the apparatus can be used again.

Other objects and advantages of the invention will appear from the following description of a preferred embodiment thereof, reference being made to the accompanying drawings wherein:

FIGURE 1 is an axial section through the tool and the bottom of a well bore; and

FIGURE 2 is an elevation, partly in section, showing an ignition device used with the tool.

Referring to FIGURE 1, there is shown the lower end of a well bore **10** with a piece of junk such as a lost of broken drill bit **11** at the bottom of the bore. Within the well bore is a string of pipe **12** whose lower end is provided with a threaded socket or tool joint **13** which may be integral with the pipe as shown. A drill collar **14** is screwed into the tool joint. In the lower end of the drill collar is screwed a tubular firing sub **15** which is of drill collar diameter.

A plurality of electrically conducting leaf springs **16** are screwed to a conducting ring **17** which is set in a recess **18** in the threaded pin **19** of the upper end of the firing sub **15** and secured thereto by a threaded pin **20**. Near the lower end of the sub **15** there are a plurality of downwardly directed passages **21**. The bottom of the firing sub has a slight inturned flange or shoulder **22**. To the lower end of the firing sub is connected a steel bumper sub **30** having an internally threaded socket **31**. The upper end of the bumper sub **30** abuts against the lower end of firing sub **15** and is provided with a tubular pin **32** which extends up into the lower part of firing sub **15**. A lock washer **33** is disposed around pin **32** and rests on shoulder **22** of the firing sub. A nut **34** is screwed to the threaded exterior of the upper end of pin **32** and rests on lock washer **33**. By this means the bumper sub is held to the firing sub.

The bumper sub has a slightly smaller outer diameter than the outer diameter of the firing sub. The lower end of the firing sub is bevelled at **35** where the passages **21** terminate and the upper part of the bumper sub is bevelled

at **36**. In this manner the passages **21** are directed downwardly as much as possible without their direction intersecting the bumper sub while still providing a bumper sub of large outer diameter to hold the explosive charge next to be described.

A charge housing **40** made of aluminum or other readily combustible or frangible material has an outer diameter equal to that of the bumper sub. The upper end of charge housing **40** has a threaded pin **41** which fits into socket **31** in the lower end of the bumper sub. Inside the charge housing **40** is disposed an explosive charge **42** having a conical lower end **43** which shape directs downwardly a large proportion of the effect of explosion of the charge. The charge is retained within the housing **40** by means of an aluminum plug **44** held to the lower end of the housing by screws **45**. The lower face of plug **44** is tapered to a point **46** to facilitate penetration to the bottom of the well bore.

An electric firing cap **50** is disposed adjacent the upper end of charge **42**, being disposed in passage **51** in pin **41**. One electric contact at the upper end of the cap is soldered to the lower end of an electrically conducting brass rod **52** whose upper end is screwed into a steel point **53** forming an electric contact means. Around the rod **52** is an electrically insulating sleeve **54** disposed inside a steel tube **55**. The latter extends through passage **51** and pin **32** up into the firing sub **15**. There is a flange **56** on tube **55** which rests against the bottom of a counterbore **57** in the bumper sub **30** and is held thereagainst by the upper end of pin **41**. An O-ring **58** seals between tube **55** and passage **51**. A wire **59** is soldered to tube **55** and the other electric contact of electric firing cap **50**.

Referring now to FIGURE 2, there is shown a firing device adapted to be lowered on a wire line **70** into the chamber **71** inside the firing sub **15** to set off charge **42**. The firing device comprises a rope socket **72** connecting the wire line to a fishing neck **73** which is screwed into the top of a go devil or sinker bar **74**. There are a plurality of electrically conducting belly springs **75** secured to the outside of the sinker bar which serve both to ground the firing device to the firing sub and to center the firing device in its passage down the drill pipe into the firing sub.

The lower end of the sinker bar is screwed into the top end of tubular battery chamber **76** in which is disposed an electrically insulating sleeve **77** and a plurality of dry cells **78** disposed with their contact pins **79** extending down. The dry cells are supported at their lower end by electrically insulating bushing **80** secured into the lower end of chamber **76** and a contact pin **81** screwed into bushing **80** and engaging contact pin **79** of the lowermost dry cell. Electrically conducting compression spring **82** disposed between the top of the uppermost dry cell and the pin on the lower end of the sinker bar keeps the dry cells in contact with each other and connects the metal bottom forming one contact of the topmost cell to the sinker bar and battery chamber.

In operation the tool is lowered into the well bore and with the aid of the weight of the drill collar **14** and the action of the fluid circulating down the drill pipe and out passages **21** and back up the well bore getting the detritus at the bottom of the well bore out of the way the tool is positioned adjacent junk **11**. Then the firing device is lowered into the firing sub and contact **81** engages point **53** and the springs **75** and **16** connect the firing device to the firing sub, thereby closing a circuit from the dry cells through the electric firing cap **56** to set off charge **42**. The explosion breaks up junk **11** into small fragments which can be recovered with conventional fishing tools, such as a permanent magnet fishing tool. The explosion also destroys aluminum housing **40** which is powdered or vaporized so as to leave no additional junk

in the well bore. The bumper sub is deformed so as not to be reuseable but will usually be retained on the lower end of the firing sub so that it can be easily retrieved. The bumper sub acts as a shock absorber to protect the firing sub so that it is undamaged and can be reused.

While a preferred embodiment of the invention has been shown and described, many modifications thereof can be made by one skilled in the art without departing from the spirit of the invention and it is desired to protect by Letters Patent all forms of the invention falling within the scope of the following claims.

I claim:

1. A tool adapted to be run on the end of a string of pipe for breaking up junk in a well bore comprising a charge housing means readily disintegrated by the explosion of the contained charge containing an explosive charge shaped to direct the force of its explosion downwardly, said housing being closed at both ends except for a passageway through the upper end thereof, a bumper sub means that will integrally survive an explosion and having an outer diameter as large as the charge housing means connected to the upper end of the charge housing means and shielding the upper parts of the tool from the effects of explosion of the charge, said bumper sub being of short axial length compared to said charge housing means, said bumper sub having a passageway therethrough connecting with said passageway in the upper end of said charge housing means, means in said passageways for setting off said charge including an electric conductor extending upwardly from the upper end of said bumper sub and an electric detonator having one terminal connected to said conductor and the other terminal grounded, a firing sub connected to said bumper sub, said firing sub having an axial passage therein open at its upper end, the lower end of said passage being closed by said bumper sub and receiving the upper end of said electric conductor, said firing sub having a plurality of azimuthally spaced apart elongated passages each connected to said axial passage at one end and extending downwardly and outwardly at an acute angle to the axis of the firing sub and opening to the outside of the tool just above and radially clear of the upper end of the bumper sub, means carried by the firing sub for grounding an electric go-devil received in the firing sub, and means for connecting the upper end of the firing sub to a string of pipe, whereby the tool can be brought into effective position adjacent a target in the bottom of a hole by the combined action of the weight of the string of pipe and the action of fluid under pressure passing down through the pipe string and out through said azimuthally spaced apart passages in the firing sub immediately above the bumper sub and charge housing means and said charge can then be exploded to act on the target following which the firing sub and bumper sub can be withdrawn and the bumper sub removed and the remainder of the tool reused.

2. A tool adapted to be run on the end of a string of pipe for breaking up junk in a well bore comprising a tubular charge housing means having upper and lower ends and including means closing the upper and lower ends thereof, an explosive charge disposed in said housing and shaped to direct the blast of its explosion downwardly, and means connected to said charge housing means for connecting said charge housing means to such a string of pipe and including downwardly directed fluid passage means for conveying fluid from said pipe to the outside of said charge housing means and for directing such fluid downwardly along the outside of said housing means, the passage formed between said tubular housing means and the well bore that exists when the tool is run into a well bore conveying the fluid to the region beneath said housing means to wash detritus away from junk in the well bore beneath the tool and enable the explosive charge to be positioned closely thereabove whereby the downward blast of the explosion of the charge will act directly on the junk, and means for setting off the explosion of said charge, said tool being further characterized by the fact that the means for connecting the charge housing means to the string of pipe and including downwardly directed fluid passage means includes a drill collar adapted to be connected to the lower end of the string of pipe and a tubular firing sub connected to the lower end of the drill collar having the same inner and outer diameters as the drill collar providing a thick wall in the lower part of which are disposed said downwardly directed fluid passage means and providing a central chamber adapted to receive an electric go-devil of the largest diameter that will pass through said drill collar after said go-devil has downwardly traversed the interior of the string of pipe to which the tool is connected, the means for setting off an explosion of said charge including resilient electric contact means around the upper part of said central chamber of said sub and extending inwardly therefrom to engage the go-devil, said tool being further characterized by the fact that the charge housing means is made of readily destructible material that is reduced by the explosion of the charge to a form compatible with continued drilling in the well bore and in which there is interposed between the charge housing means and the firing sub a bumper means of durable material that will survive the explosion of the charge, said bumper means being of short axial extent compared to the length of said tubular charge housing means, the said fluid passage means in the lower part of the firing sub terminating at the lower end of the firing sub where it engages said bumper means, the outer diameter of the bumper means being less than that of said firing sub, the bumper means being substantially clear of the path of fluid emerging from said fluid passages in the firing sub, the outer diameter of said bumper means being as large as that of said charge housing means to protect the firing sub from explosion of said charge.

3. A tool adapted to be run on a string of pipe for breaking up junk in a well bore comprising housing means for containing an explosive charge and disintegrating fully after the explosion of said charge, bumper means connected to one end of said housing means made of material such that the bumper means survives explosion of such charge, fluid discharge means connected to said bumper means on the opposite side thereof from said charge housing means, said bumper means being of as large a diameter as said charge housing means and serving as a buffer between said fluid discharge means and said charge housing means, an explosive charge disposed in said housing means, said charge being shaped to concentrate the blast of its explosion in a direction away from said bumper means, said fluid discharge means being connectable to said pipe to convey fluid from the interior of the pipe to the exterior of the tool and including passage means directing fluid past said bumper means toward said charge housing means in the same general direction as the blast from explosion of said charge, whereby junk in the well bore can be cleared of detritus by fluid forced down said string of pipe and through said fluid discharge means and the charge housing means positioned closely adjacent the junk with the shaped charge directed thereagainst, and means for setting off an explosion of said charge, said means for setting off an explosion of the charge including means forming a passage through the end of said charge housing means adjacent said bumper means and thence through said bumper means into an interior space in said fluid discharge means, an elongated unit disposed in said passage including an electric firing cap at one end of the unit adjacent the charge in the charge housing means and two concentric conductors insulated from each other and extending up into said space in said fluid discharge means, the innermost of said conductors extending beyond the end of the outermost conductor farther into said space in said fluid discharge means to provide at its end an electric contact, the outermost of said concentric con-

ductors having a flange thereon held between and in electrical contact with said bumper means and said end of said charge housing means, said fluid discharge means and bumper means being made of electrically conductive material, and resilient electrical conductor means around the interior of said space in said fluid discharge means providing an electrical contact positioned farther from said bumper means than said electrical contact provided by the end of said innermost conductor, said interior space in said fluid discharge means opening at the end thereof farther from said bumper means to communicate with the interior of the pipe on which the tool is run, whereby an electric go-devil can be dropped through said pipe into said space to engage said contacts and set off an explosion of said charge.

4. A tool adapted to be run on the end of a string of pipe for breaking up junk in a well bore comprising a charge housing means readily disintegrated by the explosion of the contained charge containing an explosive charge shaped to direct the force of its explosion downwardly, said housing means being closed at both ends except for a passageway through the upper end thereof, an electrically actuated detonator disposed in said passageway close to the upper portion of said explosive charge, a bumper sub that will integrally survive an explosion and having an outer diameter as large as the charge housing means connected to the upper end of the charge housing means and shielding the upper parts of the tool from the effects of explosion of the charge, said bumper sub being of short axial length compared to said charge housing means, said bumper sub having a passageway therethrough connecting with said passageway in the upper end of said charge housing means, a firing sub connected to said bumper sub, said firing sub having an axial passage therein open at its upper end for the entrance of well fluid and to receive an electric go-devil, the lower end of said passage being closed by said bumper sub except for said passageway through said bumper sub which terminates at its upper end inside said axial passage in said firing sub, said firing sub having a plurality of azimuthally spaced apart elongated passages each connected to said axial passage at one end and extending downwardly and outwardly at an acute angle to the axis of the firing sub and opening to the outside of the tool just above and radially clear of the upper end of the bumper sub, electric conducting means connected to said detonator and extending through said passageways in the charge housing and bumper sub into said axial passage in said firing sub, said electric conducting means terminating at its upper end in electric contact means for engagement with said electric go-devil, and means for connecting the upper end of the firing sub to a string of pipe, whereby the tool can be brought into effective position adjacent a target in the bottom of a hole by the combined action of the weight of the string of pipe and the action of fluid under pressure passing down through the pipe string and out through said azimuthally spaced apart passages in the firing sub immediately above the bumper sub and charge housing means and said charge can then be exploded to act on the target following which the firing sub and bumper sub can be withdrawn and the bumper sub removed and the remainder of the tool reused.

5. In a tool adapted to be run in a well on a string of pipe comprising a hollow charge housing made of material that will be reduced by an explosion to a drillable state and containing an explosive charge shaped to direct the main blast of its explosion downwardly toward the well bottom, said housing further containing a detonator for said explosive charge, means for connecting the charge housing to the string of pipe, said connecting means having a fluid passage therethrough communicating at its upper end with the interior of the pipe and at its lower end by means of a downwardly directed portion with the space exterior of the tool forming the annulus between the tool and well when the tool is in the well whereby fluid can be circulated down inside the pipe through the tool into the annulus, said connecting means including a firing sub adapted to contain an electric power means, electric contact means in said firing sub, and means electrically connecting said contact means to said detonator, the improvement according to which said firing sub is open at the top to receive said electric power means as part of an electric go-devil run in through said pipe, said downwardly directed portion of the fluid passage is elongated and extends from the interior of said firing sub all the way to the exterior of the tool to form the fluid leaving said passage into a jet stream directed downwardly toward the well bottom, the distance between the lower end of said portion and the upper end of said explosive is short compared to the length of said charge, the distance between the bottom of said charge and the lower end of said charge housing is short compared to the length of said charge, and said connecting means further includes a shielding means provided by a bumper sub of as large transverse dimensions as the charge housing, said shielding means being connected between said charge housing and said firing sub, said means electrically connecting said contact means to said detonator means extending through said bumper sub, said bumper sub being of short length compared to the length of said charge.

6. A tool adapted to be run on the lower end of a string of pipe for breaking up junk in a well bore comprising:

sub means for connecting the tool to the string of pipe and providing fluid passage means communicating with the interior of the pipe and including an elongated downwardly directed restricted portion communicating at the lower end of the sub means with the space exterior of the tool that forms the annulus between the tool and well wall when the tool is in the well for forming fluid leaving said elongated portion into a downwardly directed jet stream,

charge housing means disposed below said sub means and containing an explosive charge shaped to direct the force of the explosion downwardly and disposed with the bottom of the charge adjacent the bottom of said housing means and the top end of the charge adjacent the top of said housing means,

said housing means also containing a detonator and being closed at both ends except for a passage through the upper end leading to the detonator and being made of material readily disintegrated by the detonation of the contained charge, and

a bumper sub connected to and interposed between the top of said charge housing means and the bottom of said connecting sub means and made of material that will integrally survive an explosion and having a vertical extent that is short compared to the vertical extent of said charge placing the lower end of said jet forming portion of the fluid passage means close to the charge housing means and having horizontal dimensions in all directions as large as said charge housing means to shield the portion of the tool thereabove from the effects of the detonation of the charge.

References Cited in the file of this patent

UNITED STATES PATENTS

2,058,287	Anderson	Oct. 20, 1936
2,293,259	Johnson	Aug. 18, 1942
2,760,408	Taylor	Aug. 28, 1956
2,869,825	Crawford	Jan. 20, 1959
2,876,843	Huber	May 16, 1959