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METHOD OF EXTRACTING BROKEN DRILLS AND THE LIKE

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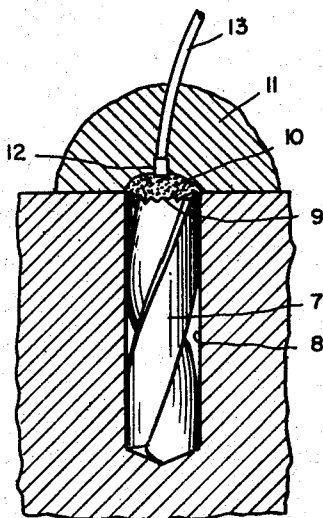


Fig. 2

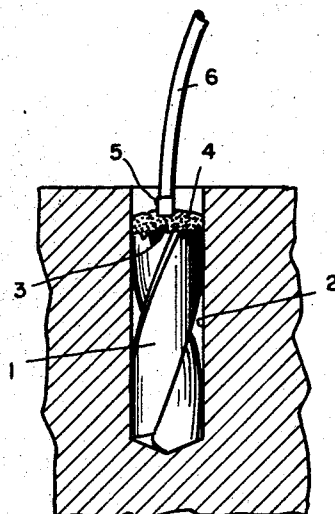


Fig. 1

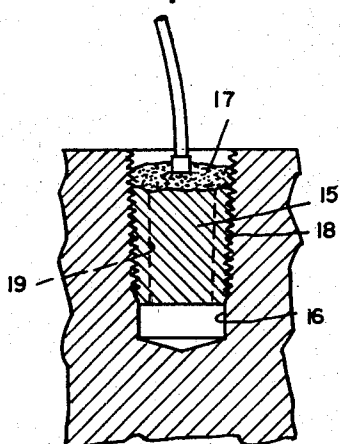


Fig. 3

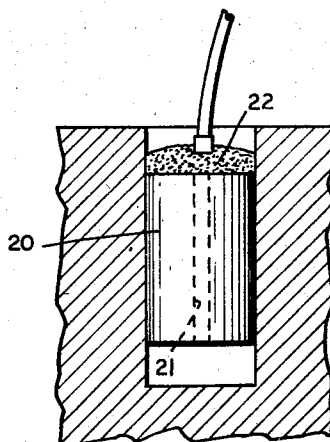


Fig. 4

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METHOD OF EXTRACTING BROKEN DRILLS
AND THE LIKE

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The present invention relates to the extraction of tool parts, such as drill bits, reamers, taps and plug gauges, from holes in metal in which such tools have become broken off, or tightly jammed or wedged. Quite frequently, the inability to remove such tool parts by expedients heretofore known has resulted in the rendering useless and scrapping of the entire metal part that is being machined.

Inasmuch as cutting tools, such as drills, reamers, taps, etc., are harder and/or tougher than the metal stock of the metal part which is being machined, it is not feasible to attempt to remove the broken or jammed tool part by drilling it out of the hole, or by attempting to remove it with a mechanical gripping device such as an extracting screw.

I have discovered that such tool parts can be efficiently, quickly and very inexpensively removed from the hole in which they are jammed or broken off by means of applying a charge of high velocity explosive, having a velocity of combustion rate on the order of 5,000 to 20,000 ft. per second. Dynamite is a commercially available high explosive well suited to the practice of the process of my invention. Other high velocity explosives which may be used are blasting gelatin, nitroglycerin, nitrocellulose, ammonium nitrate, nitrostarch and liquid oxygen explosives. My invention is particularly adapted to the extraction of fluted tools, namely, those which have a longitudinal passage, either straight line or of helical contour, which extends to the inner end of the tool and hence to the bottom of the hole in the metal part.

Briefly outlined, my invention contemplates the discharge of a small amount of explosive on the top or outermost end of the broken or jammed tool part, which results in a blowing or blasting of the tool part back out of the hole. Ordinarily it would be expected that the detonation of an explosive charge on the top of the tool part would force it deeper and tighter into the hole, but my invention is based upon the discovery that just the opposite result ensues.

My invention possesses the further advantage in that no harm or damage is done to the metal surrounding the hole from which the broken or jammed tool part is removed. Not even local stresses or strains are set up in the metal by my extracting process, as has been proven by a great many tests and inspections, such as by "magnaflux" testing.

A further object and advantage of my invention is that relatively small diameter tools, i. e.,

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those on the order of $\frac{1}{8}$ of an inch diameter, can be effectively blown free by my extraction method.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims, the annexed drawing and the following description setting forth in detail certain means and one mode of carrying out the invention, such disclosed means and mode illustrating, however, but one of various ways in which the principle of the invention may be used.

In said annexed drawing:

Fig. 1 is a sectional view showing a drill broken off below the top of the hole and prepared for removal by my extraction process;

Fig. 2 shows a drill broken off in line with the top of the hole, similarly prepared;

Fig. 3 illustrates the method of removing a tap;

Fig. 4 illustrates the method of removing a plug gauge.

Referring to Fig. 1, the broken twist drill part 1 is shown broken off and jammed in the hole 2. The top or outermost end 3 of the drill 1 is below the top of the hole 2. In this case, a charge of dynamite is placed on the outer end 3 of the broken drill, in the form of the layer 4. The amount of the charge of dynamite is relatively small, and even in the case of extracting drills or other tool parts as large as $\frac{1}{4}$ in. in diameter, not more than a thimbleful of dynamite is necessary. As a general rule, a layer of dynamite 4 having a thickness or depth not over $\frac{1}{3}$ of the diameter of the hole 2 is the appropriate amount to be used. A detonating cap 5 is then inserted in the dynamite layer 4, with the fuse 6 connected thereto. Upon lighting the fuse 6 and detonating the charge of dynamite 4, the broken drill 1 is blown out of the hole, accompanied by the ringing noise of metal striking metal.

In some instances, it is necessary to repeat the process, viz., to insert another charge of explosive and again detonate it, to remove all of the broken tool part. This is most likely to occur in the case of the extraction of large core drills which become fractured and hence must be removed piece by piece by repeated explosive charges.

Where a tool part, such as the drill 7, is broken off substantially at or above the top of the hole 8, as indicated at 9, the explosive charge is placed on top of the tool part, as indicated at 10. A mound of plastic material 11, such as putty or

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clay, is built around the top of the charge 10, the detonating cap 12 and the fuse 13.

When extracting a broken tap, such as indicated at 15, out of the hole 16, the procedure is the same as heretofore described, viz., by placing a charge 17 of dynamite on the outer end of the tap 15 and then detonating the same. In this case, however, the tap, being blown out of the hole, will strip off a section of threads 18. However, strange to relate, only one portion of the entire periphery of the threads 18 will be cut off. This portion of cut off threads corresponds in width or extent to one of the lands between the flutes 19 of the tap 15. After removal of the broken tap part 15, the hole 16 can then be re-tapped to a slightly oversized diameter of thread.

Although I do not wish to limit myself to any particular scientific theory of operation of my method, it is believed that the force of the blast, or the explosive gases from the charge travel down between the flutes of the tool to the bottom of the hole and there the pressure reverses itself to drive the tool back out of the hole.

In the case of a tool or tool part which does not have any channels, gashes or flutes extending from its outer to its inner end, such as the plug gauge 20 shown in Fig. 4, a small hole 21 is first drilled through the length of the plug gauge, before the explosive charge 22 is placed on top of the tool part 20 and detonated.

In cases where the outer or exposed end of the broken tool part is below the surface of the hole, it is recommended that a wire rod or probe be first used to determine the position of the end of the drill below the top of the hole, so that the operator will be able to make sure that he places the explosive charge far enough into the hole and upon the exposed or outer end of the broken tool part.

My above-described method is particularly suited for removing tool parts from deep drilled holes, which heretofore have presented the most serious problem in the removal of broken drills and the like. My invention thus results in the saving of metal parts and workpieces which would otherwise have to be scrapped, representing an important and outstanding saving not only in labor, but also material.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the means and the steps herein disclosed, provided those stated by any of the following claims or their equivalent be employed.

I therefore particularly point out and distinctly claim as my invention:

1. The method of extracting broken parts of

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tools, such as drills and the like, from holes having a closed inner end in metal parts, comprising providing a passageway for gases to the inner end of such hole, placing a small charge of high velocity explosive on the outermost end of the tool part to be extracted, and then detonating such charge and blowing the tool part back out of the hole.

2. The method of extracting fluted tools such as drills, reamers and taps from holes having a closed inner end in metal parts, comprising providing a passageway for gases to the inner end of such hole, placing a small charge of dynamite on the outermost end of the tool to be extracted, and then detonating such charge and blowing the tool back out of the hole.

3. The method of extracting broken parts of tools, such as drills and the like, which are broken off at or beyond the outer end of a hole having a closed inner end in a metal part, comprising providing a passageway for gases to the inner end of such hole, placing a small charge of dynamite on the top of the broken tool, placing a mound of inert, plastic material on top of the dynamite and surrounding the outer end of the hole, and then detonating such charge and blowing the tool part out of the hole.

4. The method of extracting cylindrical tools such as plug gauges and the like from holes having a closed inner end in metal parts, comprising the steps of drilling a passageway for gases to such closed inner end through the tool part to be removed, placing a small charge of dynamite on the outermost end of the tool part, and then detonating the charge and blowing the tool out of the hole.

5. The method of extracting fluted tools such as drills, reamers and taps from holes having a closed inner end in metal parts, comprising providing a passageway for gases to the inner end of such hole, placing a small charge of dynamite in a layer having a depth not over $\frac{1}{3}$ the diameter of the hole on the outermost end of the tool to be extracted, and then detonating such charge and blowing the tool out of the hole.

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