May 11, 1948. H. V. HARDING 2,441,319

DISINTEGRATING OR REMOVING METALLIC MATERIAL

Filed Oct. 2, 1943

Fig. 1

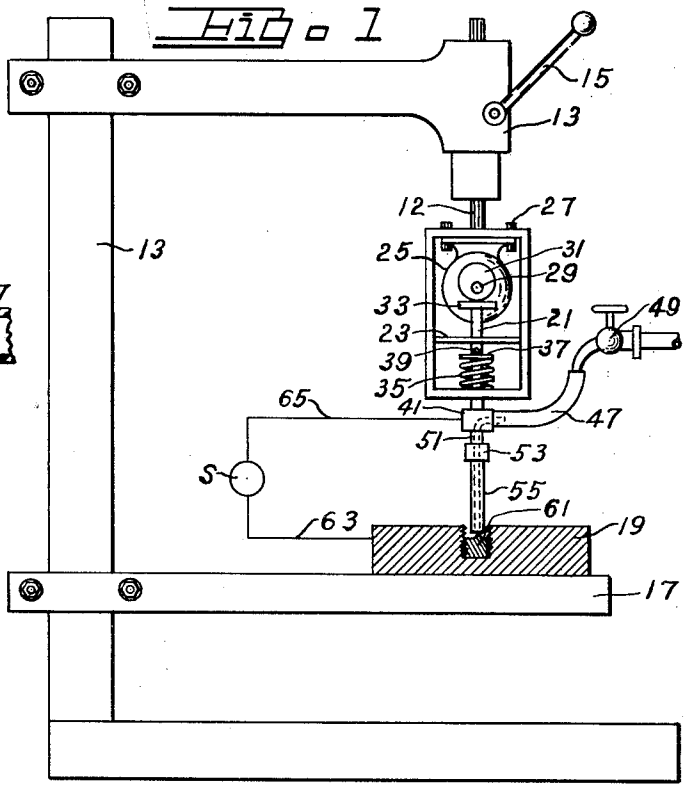


Fig. 2

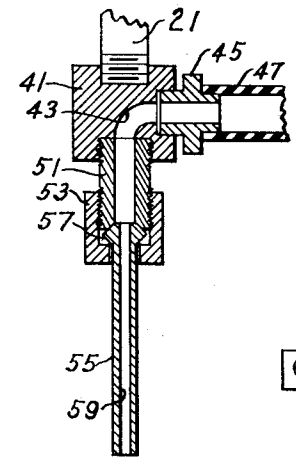
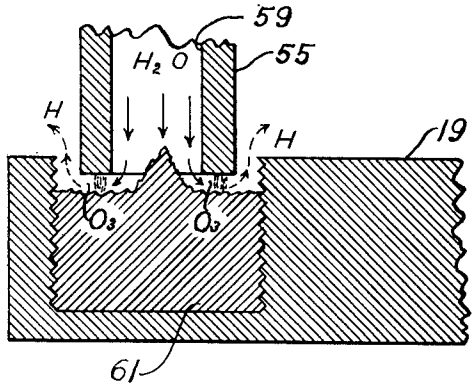


Fig. 3



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DISINTEGRATING OR REMOVING METALLIC MATERIAL

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3 Claims. (Cl. 219—15)

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My invention pertains to means for and methods of disintegrating and removing metallic materials as in piercing holes or opening plugged holes in metallic materials.

It is an object of the invention to provide an improved method of and means for conveniently and quickly disintegrating and removing metallic materials.

It is also an object of my invention to provide means for and method of rapidly oxidizing metallic materials along a desired path, cooling the work and flushing the disintegrated material away from the zone of operation.

It is a further object of the invention to provide means for and method of applying an electric arc and a flowing stream of water simultaneously to a metallic material to provide an oxidizing agent for oxidizing the material while cooling the work and flushing away the disintegrated material.

The invention itself, however, both as to its organization and its method of operation together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments, when read in conjunction with the accompanying drawing, in which:

Fig. 1 is a side elevational view showing my metal disintegrating apparatus, and diagrammatically representing its connection with a piece of work, which is shown sectioned;

Fig. 2 is an enlarged sectional view taken axially through the electrode, chuck and coolant connection block; and

Fig. 3 is an enlarged fragmentary view in section and showing the point of the hollow electrode entering the work for illustrating the operation thereof.

Referring more specifically to Fig. 1 of the drawing, the apparatus which I provide comprises a supporting structure or frame 11 having an extension 12 projecting upwardly from the center for securement in an adjustable drill press or any other suitable support 13 which may be used for adjusting or lowering the device. This is commonly accomplished by manipulating a handle, such as 15 as will be readily understood. Such a support usually embodies an adjustable shelf 17 whereupon the metal work piece 19 may be conveniently disposed.

In accordance with my invention I provide a rod 21 which passes slidably through an aperture in the bottom side of the support frame 11 which may be provided with a transverse brace 23 through which the sliding rod is also passed to

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limit and guide its movements. For reciprocating or vibrating the sliding rod axially, I provide any suitable motor means device 25 which may be operated by means of compressed air or water under pressure, or which might be a small, geared electric motor as desired. Such a motive device is compactly and rigidly mounted within the frame structure 11, as by means of bolts 27 passing through the pedestal and the upper side of the support frame 11. A projecting shaft 29 of the motor is provided with a cam 31 keyed or secured firmly thereon, in any well known manner. The upper end of the sliding rod 21 is provided with a tappet head or plate 33 for operatively engaging the surface of the cam. A compression spring 35 is centrally disposed on the sliding rod 21 which also carries a washer 37 secured under a pin 39, which compresses the upper end of the spring by which the tappet 33 is urged upwardly to operatively engage the cam 31. As the motive means 25 operates and rotates the cam 31, the sliding rod 21 is reciprocated up and down through the associated support and guiding structures.

The lower end of the sliding reciprocating rod 21 extends below the lower side of the support structure 11 where it is firmly connected into a fluid connection block 41 as by being threadably inserted, as may be seen in Fig. 2. The fluid connection block 41 is provided with a fluid passage 43 which may open from one side of the block provided with a hose fixture 45 for receiving a suitable hose 47 which extends for connection with any suitable source of coolant water under pressure, which may be the usual service faucet 49. In the fluid connection block 41 the fluid passage 43 opens from the lower side into a tubular connector 51, extending therefrom and threaded at the lower end for receiving a chuck collar 53.

Electrodes 55 are provided of elongated rod-like conformation having an engaged head 57 at the upper end. The electrode head has upwardly turned conical surfaces which are clamped snugly up into the bore in the lower end of the connection tube 51 as the chuck collar 53 is turned up thereon, serving to snugly clamp and center the electrode in the holder. The electrode is provided with a fluid conducting passage 59 extending therethrough from end to end, and tightening up the chuck collar 53 serves not only to secure the electrode but also accurately aligns the fluid flow conducting passage.

In operation, the working piece of metal 19 which is to be pierced, or which may have a

piece of metal 61 therein, which it is desirable to remove, is connected by a conductor 63 to one terminal of any suitable current source which may provide heavy currents of low voltage, such as a welding transformer or generator. From the other terminal of the current source S a conductor 65 is connected to the electrode 55 in any suitable manner as by connecting it with the connecting block 41, as shown. The motive device 25 is started, the water faucet 49 is opened, and the support adjustment 15 is manipulated to approach the lower end of the vibrating electrode adjacent the portion of metal to be disintegrated and removed. As the point of the vibrating electrode 55 approaches the metal, electric arcs are struck thereon. By means of an electric arc in contact with metallic material, high temperatures are produced. This being accomplished in the presence of the coolant flowing through and from the point of the electrode, two chemical reactions take place. The H_2O molecules are broken down into ozone, O_3, and free hydrogen, H_2. The hydrogen passes off as a gas and the oxygen or ozone becomes extremely active with the hot metallic materials. Assuming that iron or iron alloys are the metallic materials worked on, then the ozone reacts with the iron to become ferric oxide, Fe_2O_3, ferrous oxide Fe_3O_4, plus free iron Fe. Also if the metal used for making contact with the iron is copper, then some of the copper will alloy with the iron, forming an iron copper alloy, and some of the copper will become oxidized due to contact with free oxygen. All of the oxide compounds formed being extremely hard and brittle, these are knocked off from the main body of the metal worked upon by the arc and the vibrating electrode and are carried away by an excessive amount of water used for the process. Consequently, this leaves a hole precisely the same geometrical shape as that of the part used in forming the contact.

For the above operation it is preferable to utilize electrodes made of the softer non-ferrous metals, such as copper for example, and the process is useful in removing broken drills, tappets, set-screws, etc. Also my process and apparatus is useful for drilling holes through hardened surfaces or any metallic material which are found to be difficult to work by the usual methods and tools, as well as the softer metals either ferrous or non-ferrous.

The coolant fluid utilized may, in accordance with my invention, be any fluid which will provide a suitable active oxidizing agent in the presence of the electric arc but preferably I utilize tap water for this purpose because it is conveniently available under pressure, and serves

very effectively for cooling electrode and the work to prevent undue injury from the high temperatures and also it is very effective to flush away the disintegrated materials. Such water is not pure H_2O but in practically all cases comprises an aqueous solution, and where I have mentioned water, it is not my intention to limit the water to chemically pure or distilled water, only.

It is apparent that within the scope of my invention modifications and different operations or arrangements may be made other than specifically disclosed herein, and the present disclosure is illustrative merely, the invention comprehending variations thereof.

I claim:

1. In a method of removing portions of electrically conductive material, the steps of alternately making and breaking an electric arc between an electrode and said material, and continuously directing a cooling stream of water upon said material at the seat of said arc.

2. An apparatus for disintegrating and removing portions of metal, an elongated electrode, means for forming an intermittent arc between said electrode and said metal including means for vibrating said electrode along its length, and means for directing a stream of water upon said arc at its seat on said metal.

3. A method of disintegrating and removing metal which consists in, establishing an electric arc between an electrode and the metal body to be cut, repeatedly interrupting the arc by relative movement between the electrode and metal body in a direction to attenuate the arc, and directing a stream of water against the arc seat on the metal body to cool the metal in the vicinity of the arc and vacate the metal liberated by the arc.

HENRY V. HARDING.

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