

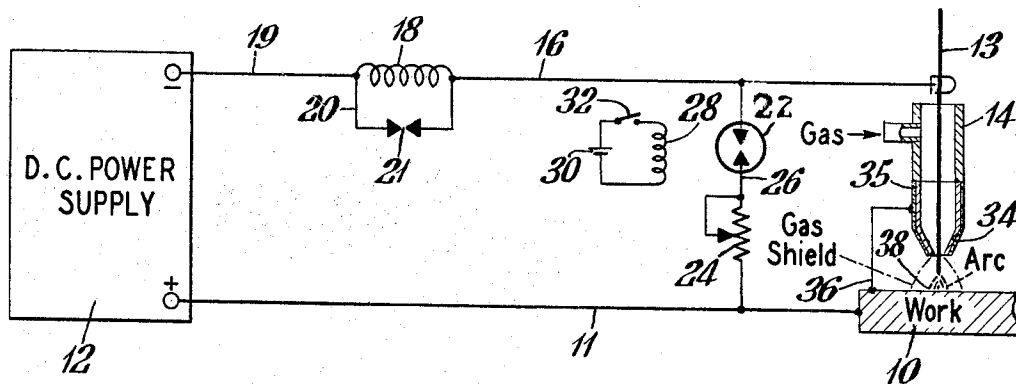
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ARC STARTING APPARATUS AND METHOD

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**ARC STARTING APPARATUS AND METHOD**  
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This invention relates to work-in-circuit arc welding, and more particularly to the starting of inert gas-shielded non-consumable electrode arcs.

According to the invention the relatively non-conductive cup or nozzle of a torch is coated with suitable material that is more conductive than that of such cup. Such coating is, in turn, connected by a ground circuit directly to the metal work. Thus, when an electrical impulse is applied to a gap between the end of an electrode in the cup, and such work, starting of the main arc is assured.

Prior to the present invention, in the repetitive impulse starting of gas-shielded D.C. welding arcs, a serious problem arose in that occasionally the arc or arcs failed to start, spoiling the intended result. While the use of continuous high-frequency is a possible solution, the latter introduces undesirable interference with other equipment unless properly shielded, which is expensive. Also high frequency starting has proved unreliable under various circumstances.

The main object of this invention is to solve such problem without the use of high frequency, at a minimum of expense, and with increased reliability of starting, particularly under repetitive starting conditions, and even when the electrodes are cold and the arc gaps are relatively long.

The invention provides a method of starting a working arc between an electrode and a workpiece, wherein the electrode is surrounded by an insulating gas cup with its surface bearing a relatively conductive coating and the coating is connected to the workpiece, the arc being initiated by impressing a high voltage impulse between the electrode and workpiece, of the same polarity as that of the arc power supply voltage.

In the drawing, the single figure is a circuit diagram illustrating an example of the invention.

As shown in such drawing, the work 10 is connected by a ground lead 11 to one terminal of a D.C. power supply 12 of the conventional constant current type. Electrode 13 of a gas-shielded arc torch 14 is connected to the other terminal of such power supply 12 by lead 16 through an inductive choke 18 and conductor 19. Such choke 18 may be provided with a shunt circuit 20 containing a protective spark gap 21. A normally closed vacuum switch 22 and an adjustable resistor 24 are connected in a series circuit 26 across the leads 11 and 16. A relay coil 28 is adapted to open switch 22 when energized by battery 30 upon closure of switch 32.

The torch 14 includes a gas cup or nozzle 34 through which inert gas, such as argon, flows downwardly, shielding the welding operation on work 10 from the atmosphere. The cup 34 is composed of ceramic, such as lava, that is electrically non-conductive. On the outer surface of such cup 34, there is a coating 35 of material having an electrical conductivity relatively higher than that of the cup, such as dry molybdenum disulfide (powder), or a conductive coating compound of graphite. The latter is applied as a liquid on the outer side of the cup 34, providing a coating 35 that is conductive when dry. Such coating 35 is connected to the work 10 by a conductor 36.

In operation, when the circuit is connected as shown, a current builds up in the choke 18 by way of vacuum

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switch 22 and resistor 24. Thus, upon the opening of such switch 22 by closure of switch 32, the arc gap 38 between the end of electrode 13 and work 10 is broken by the resulting single relatively high voltage pulse generated due to the interruption of current through choke 18, and arc welding current then flows across the gap 38. The conductive coating 35 on the nonconductive cup 34, which is grounded to the work 10 by conductor 36, acts to assure such arc starting, even when the parts are cold and/or the arc gap 38 is relatively long under repetitive starting conditions.

As an example of the invention under actual working conditions, the parameters were as follows:

The power supply was adjusted to supply 80 volts (open circuit) across its output terminals.

The choke 18 had a rating of 10 millihenries at 15 amperes current—swinging to less than 100 microhenries at 200 amperes current. The protective spark gap 21 had a spacing of .045" between the points thereof, which would act to limit the rise of voltage across the choke to a safe level below 5000 volts in the event of a misfire.

The vacuum switch 22 was rated at 15 amperes current, and was actuated at 26.5 volts D.C.

Resistor 24 was adjusted to provide a resistance of about 6 ohms to set the current in circuit 26 at 15 amperes.

Torch 14 was one of the inert gas-shielded non-consumable (tungsten) electrode spot-welding type, and the arc shielding gas was argon.

The workpiece was sheet metal composed of carbon steel, and the welding time cycle was critical to avoid burn-through.

The voltage of the starting pulse was 2500-3000 volts for an arc gap of  $\frac{3}{32}$ " between the end of electrode 12 and work 10.

While the grounding circuit 36 is preferred, it may in some cases be omitted, since the coated cup of the invention improves arc starting compared to that with uncoated cups.

What is claimed is:

1. Work in circuit, nonconsumable electrode, inert-gas shielded arc working system, comprising in combination: a torch provided with a gas cup, the body of which is composed of insulating material having conductive means encircling such body; grounding means connecting such conductive means to the work; work arc circuit means for applying and maintaining a working arc potential across a gap between the end of a nonconsumable electrode supported in such torch and the work in a stream of inert gas flowing through such cup, and means for applying an electrical pulse at a potential sufficient to break down such gap, rendering it conductive and establishing a working arc, the polarity of such pulse with respect to the work being the same as that of the working arc potential, such pulse acting in conjunction with such conductive means and such grounding means to facilitate the establishment of such working arc the resistance of such grounding means and such conductive means in combination being of substantially lower conductivity (higher resistivity) than that of the work arc circuit.

2. Arc starting apparatus comprising, in combination, means providing an arc gap in a stream of inert gas, a D.C. power supply circuit connected to said means, a ceramic cup for directing such gas about such arc, a choke connected in said circuit, a choke charging circuit containing a vacuum switch and a resistor connected in parallel with such arc gap, and means for opening said vacuum switch to cause the choke to discharge across such gap, thereby starting the arc, said cup having an annular conductive coating for improving such starting,

and means connecting said conductive coating to the positive side of such arc gap.

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