

ARC PLASMA RECYCLING OF FREON'S

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The work is dedicated to design of electric arc reactor for Arc Plasma Recycling of Freon's. We have created the design of arc plasma reactor with long electric arc for plasma chemical recycling of Freon's with following characteristics:

Simple and cheap electric arc plasma reactor with a long arc discharging in the steam of Freon's and other components, which skipped in the reactor.

Putting of electric power in the installation with less current and higher voltage. By doing this, arc plasma reactor's energetic, technological and economic indicators are improved at least by factor of two. Since the mass, size and energy loss of the arc plasma reactor are roughly proportional to the square of the current, the figures not less than 10 times better are expected in the proposed device. Advantages of design of the arc plasma reactor are:

Cost effective recycling of Freon's.

Environmentally friendly technology without releasing hazardous substances.

Keywords: *plasma, ozon, freon, recycling*

Chlorofluorocarbons (CFCs) are potent Ozone Depleting Substances (ODS) and greenhouse gases (GHG). For example, the GHG emission factor for R-12 (dichlorodifluoromethane) is 10,900 times that of CO₂. Hydro fluorocarbon (HCFC) refrigerants are safe for the ozone layer but are potent greenhouse gases. GTU has developed the Arc Plasma Reactor for Plasma recycling of Freon's which uses steam plasma to hydrolyze CFC's and HFC's into CO₂, HCl and HF. The acid gases HCl and HF are easily neutralized in a wet scrubber. The volume of flue gas produced is reduced by more than 60 times compared to a conventional incinerator. The resulting compact plasma system opens the door to treatment of used refrigerants. The work is dedicated to design of arc plasma reactor with long electric arc for plasma chemical recycling of Freon's via decomposing of the Freon's in the long electric arc through which skipped the steam of Freon's and other components for recycling. Device for plasma chemical recycling of Freon's is placed in the steam of Freon's and steam of water and other components. The long arc is burned directly in the steam of Freon's and steam of water and other components. Several processes are happening in the steam of Freon's and steam of water and other components for recycling of Freon's. Arc decomposes water into two components - the hydrogen and atomic oxygen. The oxidation potential of the atomic oxygen is very high and it is superior to the oxidation potential of the ozone. By decomposing the water by the long electric arc, atomic oxygen is formed directly. Thus during the decomposition of water by long electric arc, a very strong oxidizing medium is formed and all materials are oxidized and they might be converted. Based on these principles, we design a arc plasma reactor with long electric arc for plasma recycling of Freon's via decomposing of the

Freon's in the long electric arc through which skipped the steam of Freon's and other components for recycling.

The basis of the proposed work is the new principle of operation of electro physical process, which enables the creation of new types of electro physics devices. The advantages of these new types of electro physics devices include two fundamental innovations: 1) the possibility to create a technically simple formation of plasma flow by means of a long electric arc and 2) a method to create a fixed current source (FCS), with the rectangular volt-ampere characteristic.

We consider two types of electric arcs, short arc and long arc. An electric arc is short if the ratio of the voltage (V) of the arc to the current (A) of the arc is less than two, and an electric arc is long if the ratio of the voltage (V) of the arc to the current of the arc (A) is greater than two. Currently only a short arc is used. Around 25% of world energy consumption falls on short arc (electric welding, electro arc furnaces, plasma furnaces, plasma cutting and plasma spraying etc.) Currently long arc is not used though the long arc contains many new technical and technological applications. Long arc is not used because it is impossible to ensure a stable operation of a long arc through the voltage sources which are currently used. The stable operation of the long arc became possible after the establishment of the fixed current source having rectangular volt-ampere characteristics and dynamic properties ensuring stable operation of the long arc. One can expect that electro physics devices powered by fixed current source takes around 10-15% of world energy consumption. This means that electro physics devices powered by fixed current source would have virtually unlimited applications.

We elaborated namely on fixed current source for arc plasma reactor. We have created and then tested in the framework of financing of the Proliferation Avoidance Initiatives Programmed of US Department of Energy (BNL-T2-0393-GE) fixed stable current power supply, which provides long electric arc creation, its stable functioning and has possibility of the arc length regulation. The principle of generating plasma by a long electric arc discharging in the water has been developed. This is achieved by using our USA patent (# 4,378,522), several patents USSR and Georgia, also by using new ideas, innovations and Know-How that we have now. Based on these principles, we first design a arc plasma reactor with long electric arc for plasma recycling of Freon's via decomposing of the Freon's in the long electric arc through which skipped the steam of Freon's and other components for recycling of Freon's (please see fig.1).

In results is created the design of arc plasma reactor with long electric arc for plasma chemical recycling of Freon's with following characteristics:

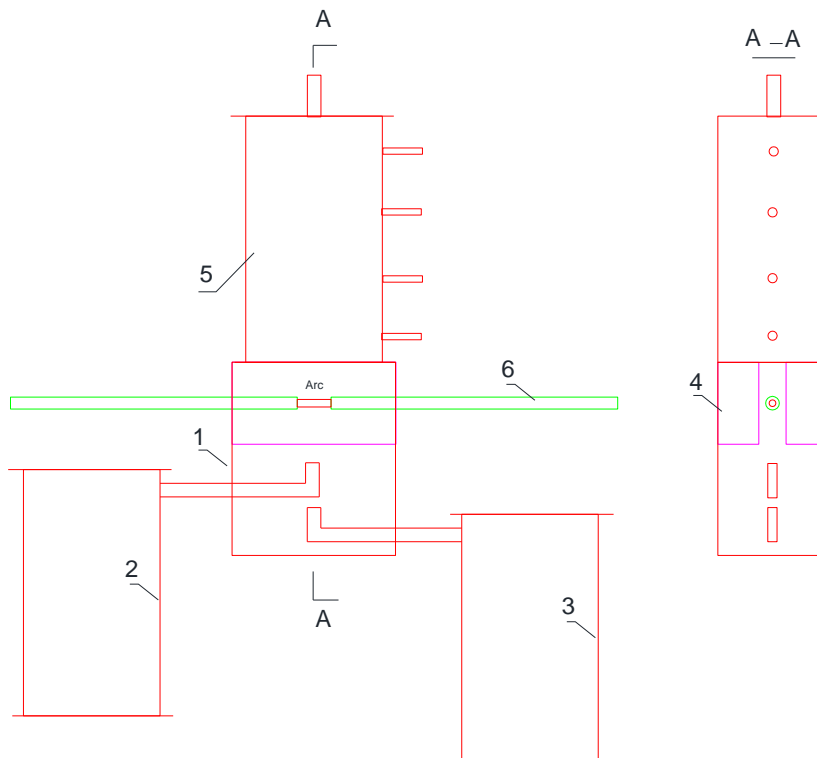
1. Simple and cheap electric arc plasma reactor with a long arc discharging in the steam of Freon's and other components, which skipped in the reactor.

2. Putting of electric power in a proposed installation with less current and higher voltage. By doing this, arc plasma reactor's energetic, technological and economic indicators are improved at least by factor of two. Since the mass, size and energy loss of the arc plasma reactor are roughly proportional to the square of the current, the figures not less than 10 times better are expected in the proposed device.

3. Advantages of the design of the economically effective and technically simple arc plasma reactor with a long electric arc which is powered from a fixed current source having

rectangular volt-ampere characteristic and which assigned to design arc plasma reactor for plasma chemical recycling of Freon's via decomposing of the Freon's in the long electric arc are:

1. Cost effective recycling of Freon's.



Specification				
n	Name	Technical Data	N	Note
1	Arc Plasma Reactor	S = 3mm	1	
2	Freons		1	
3	Steam		1	
4	Fire Brick		2	
5	Separator of Gases		1	
6	Electrode		2	

Fig. 1. Arc plasma reactor with long electric arc for plasma chemical recycling of Freon's

2. Environmentally friendly technology without releasing hazardous substances
An idea of creation of environmentally and energetically high effective arc plasma reactor for plasma chemical recycling of Freon's is new and it is natural that, to its realization ready approaches and methodology do not exist. General technical approaches and methodologies which was used:

Analysis of the composition of Freon's, the publications about for plasma chemical recycling of Freon's was studied;

Development of electrician scheme of the arc plasma reactor, the methods of analysis of nonlinear and no stationary electrical circuits was applied;

Analytical determination of the components of the electrical scheme of the Arc Plasma Reactor, theoretical methods of calculation of separate units was applied;

Analytical determination of components of gas and hydrodynamic scheme of Arc Plasma Reactor, theoretical methods of determination of the components of gas and hydrodynamic units for arc plasma reactor was applied;

Development and manufacture of laboratory model of Arc Plasma Reactor in power 10 kW the following works was carried out for aerodynamic, voltage-current, thermal and other characteristics of the new Arc Plasma Reactor in power 10 kW:

development of electric circuit of the power source having properties of the current source (converter of voltage source into the fixed current source);

calculation of the electric and electromagnetic elements of the fixed current source; development of the technical project for fixed current source;

manufacturing of the fixed current source.

Investigation of main parameters of fixed current source. Also the graphical, design and experimental methods was applied.

Experimental investigation of gas-dynamic, aerodynamic, voltage-current, thermal and other characteristics of new arc plasma reactor in power 10 kW was made; To the development of electric circuit for fixed current source having properties of current source (converter of voltage source into the fixed current source) was made: calculation of electric and electromagnetic elements of fixed current source; development of the technical project for fixed current source; manufacturing of fixed current source;

Investigation of main parameters of fixed current source. Also the graphical, design and experimental methods was applied.