

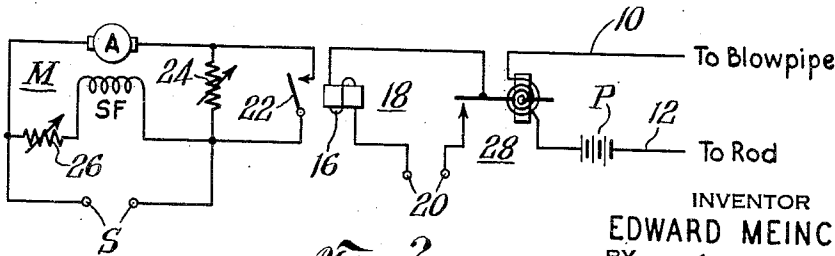
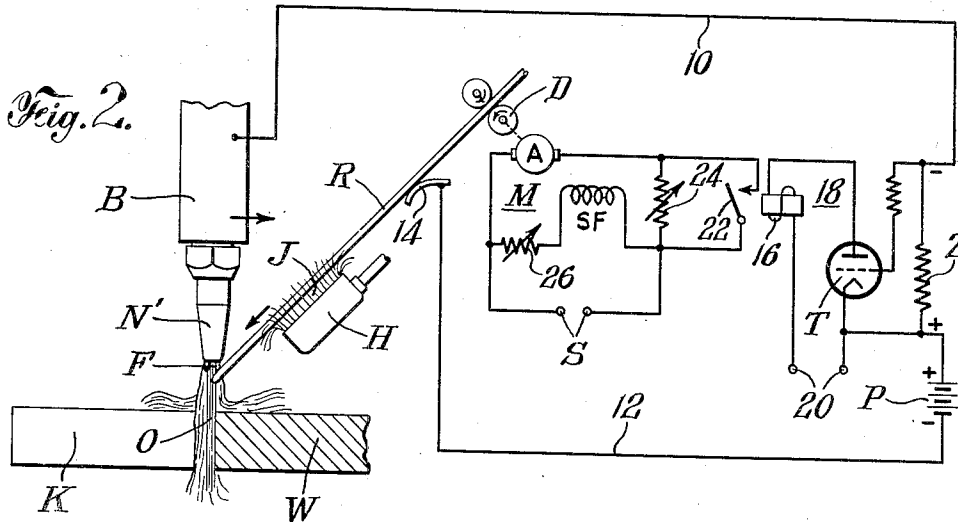
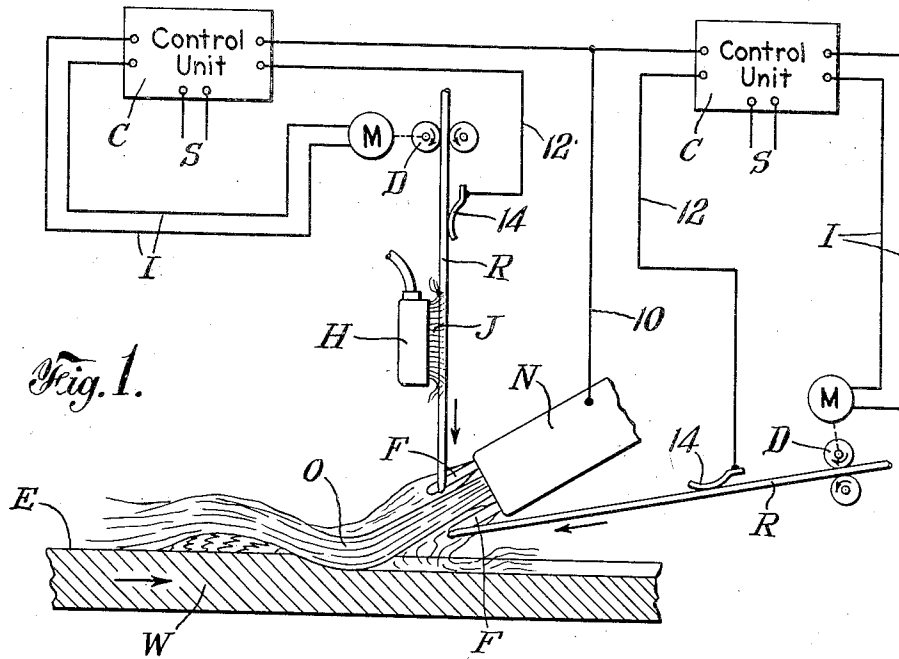
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AUTOMATIC ROD FEED FOR METAL REMOVAL

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AUTOMATIC ROD FEED FOR METAL
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This invention relates to the removal of metal thermochemically from a body composed of metal, such as stainless steel, which ordinarily cannot be cut or machined by the oxy-fuel gas process.

In the thermochemical method of cutting stainless steel with heat and a stream of oxygen, it is known practice to feed a piece of ferrous metal into the reaction zone by hand. However, such practice was relatively slow and inefficient, because an insufficient quantity of ferrous metal is fed into the reaction zone, and the process was dependent upon the skill of the operator. Also, it resulted in a rough kerf, and was not applicable to precision cutting, but was confined to demolition work.

The main object of this invention is to eliminate the human element and insure that a sufficient quantity of ferrous metal is fed continuously into the reaction zone, by the provision of a novel method of and means for feeding the ferrous metal or other adjuvant material in accordance with the need therefor; another object of the invention is to increase the speed and efficiency of the operation by the provision of means acting to preheat the adjuvant material prior to its introduction into the reaction zone; other objects are to provide automatic means for controlling the rate at which the adjuvant material is fed into the reaction zone as a function of the use thereof, and reducing the cost of the process by the use of adjuvant material in the form of inexpensive iron wire, for example.

According to the invention, in order to increase the speed of the process, the adjuvant material in the form of a solid member, such as an iron rod or wire, is preheated to elevate its temperature to a point approaching that of the ignition temperature so that the metal burns more rapidly when it is moved into line with the cutting oxygen stream issuing from the blowpipe nozzle. A continuous and ample supply of burning iron is thus provided in the oxygen stream which results in raising the temperature of such stream, as well as the deposition on the surface of the work, of molten and burning iron which raises the temperature of the stainless steel surface to the melting point at which place a thermochemical reaction occurs and the molten surface material is driven ahead and thus removed by the kinetic energy of the oxygen stream.

In carrying out this process, the rate of rod feed, the rate of cutting oxygen flow, and the speed of the desurfacing process are closely coordinated, otherwise the stability or continuity

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of the operation is adversely affected. According to the invention, such variables are properly controlled so that the process is stable. In order to regulate one of the variables, i. e. the rate of rod feed, according to the invention, such rate is governed by utilizing the conductivity of the ionized path of the work preheating gas flame. The arrangement is such that the rod is fed at a slightly higher rate than is necessary to carry out the reaction, such rate being automatically reduced when the rod is fed into the flame, so that the feeding of the rod is automatically regulated by the electrical conductivity of the flame. Thus the rate of rod feed is controlled as a function of the rod use by virtue of the conductivity of the work preheating flame.

In the drawing:

Fig. 1 is a diagrammatic view of apparatus exemplifying the invention for desurfacing or

deseaming metal;

Fig. 2 is a similar view of a modification for cutting metal, and

Fig. 3 is a circuit diagram of a control circuit modification of the invention.

Referring to Fig. 1 of the drawing, a deseaming or desurfacing blowpipe nozzle N is shown inclined in operative position with respect to work W which may be a body composed of any non-ferrous metal or stainless steel. In the illustrated example, the nozzle N discharges a characteristic stream O composed of commercially pure oxygen against the top surface of the work W as the latter is moved in the direction of the arrow with respect to the nozzle N, although it will be understood the nozzle N may be advanced with respect to the work when the latter is stationary. The nozzle N also discharges a plurality of oxy-fuel gas flames F for preheating the top surface of the work W for proper thermochemical reaction with the cutting oxygen stream O.

The flames F are electrically conductive and this phenomenon is utilized to regulate the feeding of members R composed of any suitable adjuvant material, such as ferrous metal. The members R are preferably inexpensive rods or wires composed of iron or steel. The rods R are positioned with respect to the inclined nozzle N so that one is vertical and the other is inclined and positioned under the nozzle. The vertical rod R is preheated as it is fed downwardly in the direction of the arrow by any suitable auxiliary preheating means such, for example, as an oxy-fuel gas head H which is adapted to produce a row of heating flames J which impinge on the

rod. Preheating the adjuvant material greatly improves the efficiency and stability of the de-seaming and desurfacing operation.

The rods R are fed into the flames F by feeding devices D which are driven by motors M. The input circuits I of the motors M are operatively associated with control units C which are connected to suitable sources of electrical supply by circuits S. The control units C are made responsive to the conductivity of the flames F by suitable circuits including conductors 10 and 12 which are electrically connected to the nozzle N and the rods R; both the nozzle and the rods being composed of electrically conductive material. Brushes 14 are provided for electrically connecting the conductors 12 to the rods R as the latter are fed toward the flames F by the motors M.

The inclined lower rod R is not provided with any auxiliary preheating means H because such rod is fed into a zone of very high temperature, and at a more acute angle into the work preheating flame F of the nozzle N. However, it will be understood that the inclined lower rod may be provided with auxiliary preheating means H if necessary or desirable.

In the operation of the system shown in Fig. 1, the rate at which the rods are fed into the flames F is automatically controlled by the electrical conductivity of such flames, the operation of the control units being responsive to such conductivity, and controlling the motors M in accordance therewith. Thus, adjuvant material is supplied to the reaction zone in sufficient quantity to maintain the stability of the thermochemical de-seaming or desurfacing of the surface E of the work W as the latter is advanced in the direction of the arrow.

Referring to Fig. 2 of the drawing, there is shown an oxy-fuel gas cutting blowpipe B having a nozzle N', the blowpipe being mounted on a suitable carriage (not shown) for movement in the direction of the arrow above the work W so as to form a kerf K therein as the cutting operation proceeds. A member R of suitable adjuvant material, such as ordinary iron wire, is automatically fed into the work preheating flame F and the cutting oxygen stream O of the nozzle N by feed device D which is driven by armature A of a shunt motor M. Prior to being fed into the preheating flame F of the nozzle N, the member R is moved past a flame heating head H, so that the flames J suitably preheat the member R.

The conductivity of the flame F is adapted to control the feeding rod of the member R by suitable means comprising a circuit including a battery P, conductor 10, blowpipe B, nozzle N, flame F, rod R, brush 14 and conductor 12. Such circuit also includes a resistance Z which is connected to the input circuit of a space discharge device or tube T. The output circuit of the space discharge device T includes coil 16 of a relay 18, and a suitable plate supply (not shown) connected to the terminals 20. The relay 18 also includes a normally open switch 22 which is adapted to be closed when the relay coil 16 is energized by the operation of the space discharge device T. The armature A of the motor M is connected to a suitable source of electrical supply by the circuit S through an adjustable resistor 24, the shunt field winding SF of the motor M being connected to the supply circuit S through a variable resistor 26 in series with the field winding. With the switch 22 closed the resistor 26 is adjusted so that the armature A drives

the feed device D at a certain speed which is slightly higher than that necessary to feed the rod R into the flame F and cutting oxygen stream O. When the rod R contacts the flame F, the space discharge device T is biased to cut-off, de-energizing the relay 18 causing the switch 22 to open placing the resistor 24 in the armature circuit, thus decreasing the speed of the motor armature A and the rate at which the rod R is fed into the flame.

Referring to Fig. 3 of the drawing, there is illustrated a modified control circuit which includes a meter type relay 28 connected in circuit relation with the blowpipe and a rod, so as to be responsive to conductivity of the work preheating flame. The output circuit of relay 28 is connected to a control circuit similar to that described above in connection with Fig. 2. The operation of the control circuit shown in Fig. 3 is also substantially similar to that described above in connection with Fig. 2, except that the relay 28 takes the place of the space discharge device T.

It will be understood that the illustrated examples thereof may be modified without departing from the invention. For example, the electrical conductivity of the flame may be detected by any suitable detector circuit including such flame. The invention is very effective in the removal of metal from a body composed of any metal which ordinarily resists progressive oxidation by the sole action of an oxygen jet on a heated portion thereof.

I claim:

1. The combination with a blowpipe for producing an electrically conductive oxy-fuel gas flame, and feeding means for feeding an electrically conductive rod into said flame, of automatic control means responsive to electrical current flow through such oxy-fuel gas flame between said rod and said blowpipe for automatically regulating the rate at which said rod is fed into the flame, said automatic control means comprising a relay having an input circuit responsive to changes in such current flow and an output circuit operatively associated with said feeding means for regulating the rod feeding rate to maintain a predetermined current flow through such flame.

2. Metal removing apparatus comprising a blowpipe nozzle adapted to discharge a composite stream of metal-removing oxygen and electrically conductive work-preheating oxy-fuel gas flames, feed devices adapted to feed rods of electrically conductive adjuvant solid material into the stream of oxygen, each rod being fed through at least one of such flames, separate electromotive means for driving each of said feed devices, and separate automatic means acting to control each of said electromotive means so that each rod is fed substantially in accordance with the rate of burning of such rod in such oxygen stream, each of said automatic means including an input circuit comprising such rod and said nozzle and a source of electromotive force.

3. Metal working apparatus comprising a blowpipe nozzle adapted to discharge a composite stream of cutting oxygen and at least one work-preheating oxy-fuel gas flame adjacent thereto, a feed device for advancing an electrically conductive member of adjuvant solid material through such flame into the stream of oxygen, a source of electromotive force connected to said nozzle and rod and having a circuit through such flame, and means driving said feed device, and automatic

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control means operatively associated with said driving means and said circuit for controlling the rate at which the conductive member is fed to maintain a predetermined current flow through such flame.

4. Metal working apparatus as defined by claim 3, in which auxiliary means is provided for heating the conductive member to a temperature approaching the ignition temperature of the adjuvant solid material, before the conductive member is fed into such flame, for the purpose of stabilizing the metal working operation of the apparatus.

5. In combination, means for feeding an elongated electrically conductive member of adjuvant solid material at a certain maximum predetermined rate, a cutting blowpipe for discharging means for thermochemically consuming said member including means for producing an oxy-fuel gas stream to form a work-preheating oxy-fuel gas flame and for producing a stream of cutting oxygen, and automatic means responsive to contact of such member with said flame for decreasing the rate at which such member is fed into the cutting oxygen stream, so that the member is fed at a rate commensurate with its consumption by such oxygen stream, said automatic means comprising a flame contact detector circuit including said blowpipe and such member in series relation with a suitable source of electromotive force and such flame.

6. The method of removing metal from a body composed of metal which ordinarily resists progressive oxidation by the sole action of an oxygen jet on a heated portion thereof, which method

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comprises feeding relatively to the body being treated an elongated member composed of readily oxidizable adjuvant metal into a work-preheating oxy-fuel gas flame and a stream of metal removing oxygen which are applied to such body so as to thermochemically remove metal from the body, automatically feeding the member longitudinally of itself at a substantially constant rate first into such flame and then into the stream of oxygen, and heating said member to a temperature approaching its ignition temperature with oxygen directly before it is fed into such flame, so as to increase the stability and efficiency of the metal removal operation.

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