

F. S. CALDWELL AND A. M. BENNETT.

ELECTRIC WELDING.

APPLICATION FILED JAN. 10, 1917.

1,428,529.

Patented Sept. 12, 1922.

Fig. 1.

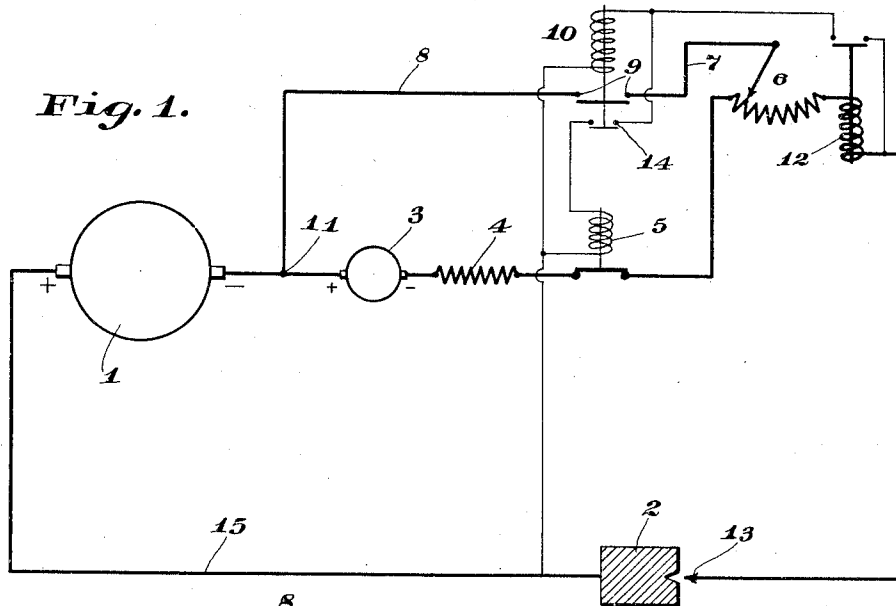


Fig. 2.

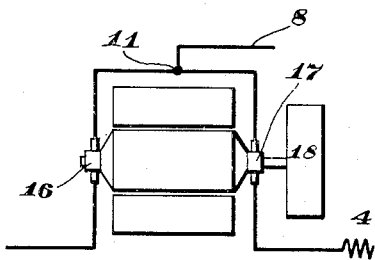


Fig. 3.

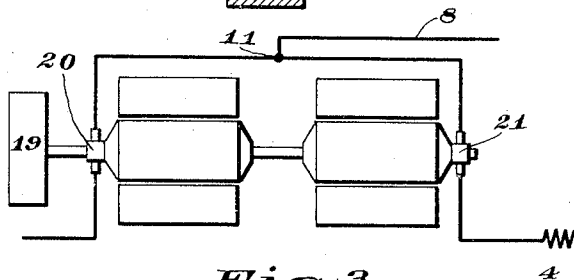
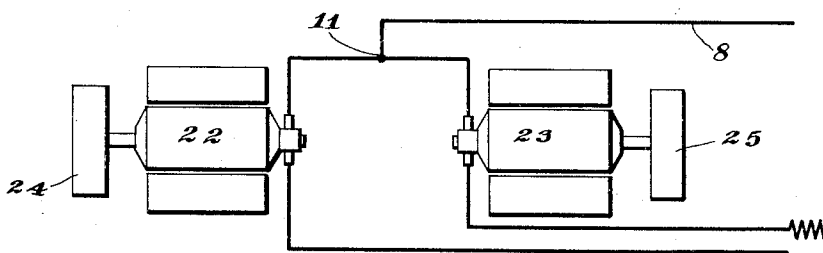


Fig. 4.

Francis S. Caldwell
and Alan W. Bennett Inventors

By their Attorney

Thomas Howe

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UNITED STATES PATENT OFFICE.

FRANCIS S. CALDWELL, OF COLUMBUS, OHIO, AND ALAN M. BENNETT, OF WESTFIELD, NEW JERSEY, ASSIGNORS, BY MESNE ASSIGNMENTS, TO BURKE ELECTRIC COMPANY.

ELECTRIC WELDING.

Application filed January 10, 1917. Serial No. 141,507.

To all whom it may concern:

Be it known that we, FRANCIS S. CALDWELL and ALAN M. BENNETT, citizens of United States, residing at Columbus, Ohio, and Westfield, New Jersey, respectively, have invented new and useful Improvements in Electric Welding, of which the following is a specification.

This invention relates to welding, brazing, repairing or the like treatment of metal by the electric arc.

Usually the work constitutes one of the electrodes, the arc being struck by touching a manually operated electrode against it. When the electrodes are separated the arc is drawn between them.

An initial impressed voltage higher than the working voltage is desirable. It makes more certain the striking of the arc even if the initial contact is prevented by dirt, rust or other causes, from being the best, and also makes the incipient arc more tenacious and has other advantages.

Accordingly the main object of the present invention is to provide improved means whereby the desired initial voltage may be obtained in an electric circuit of the character indicated and subsequently changed to normal working value.

It has erroneously been supposed that in striking the arc it was necessary to have a very large current, greatly in excess of the normal working current, to heat the point of contact and initiate rapid ionization. Such excessive currents are, however, unnecessary, as will presently be pointed out and are extremely disadvantageous for a multiplicity of reasons among which may be mentioned that the sudden overload wrenches the machinery, the apparatus must be made of greater capacity, the conductors of the circuits must be made larger and, in fact, the whole installation must be made heavier and more expensive.

It is true that if a low initial voltage is employed, a large initial current is of advantage in striking the arc to produce a profusion of vapors, thereby insuring a low resistance path for the incipient arc current. Otherwise the low voltage might be insufficient to maintain the arc.

It is not necessary that initial excessive current accompany a high initial voltage. A lower current will provide sufficient

vaporization to furnish an arc path such that the arc will be maintained by the high voltage although the arc might fail on a lower voltage. It is feasible to make the initial current less than the normal current and then increase it to normal and to make the voltage initially high and then reduce it to normal. By such procedure excessive load at any time may be prevented and the load may be applied by increments so that the disadvantages of sudden application of the load may be avoided. This may be accomplished by altering the other current controlling factors of the circuit as the impressed voltage is reduced so that the change in current will not follow the voltage but may be made to alter only slightly, may be unchanged or may change in the opposite direction. In fact the regulation of the current on change of impressed voltage by factors independent of that voltage may be made use of to produce various desirable circuit conditions under different circumstances.

It is therefore another object of the invention to provide an improved method and apparatus for regulating the voltage and current conditions in circuits of the character described.

Other and ancillary objects of the invention will appear hereinafter.

In the accompanying drawings which illustrate the invention,

Fig. 1 is a diagram of apparatus and connections of an arc welding system embodying the invention of apparatus and capable of use in practicing the method.

Figs. 2, 3, and 4, are diagrammatic views illustrating several arrangements of the generators supplying current to the circuit.

Referring to the drawings the apparatus comprises a constant potential main generator 1, one terminal of which is connected with the work 2, or metal to be welded, repaired or the like. Connected in series with the main generator is a constant potential auxiliary generator 3 which, when in operation, has its voltage added to that of the main generator. It may, however, have a smaller capacity than the main generator. In series with the auxiliary generator is a resistance 4 and the contacts of a relay 5. An adjustable rheostat 6 is connected with the contacts of the relay 5. Conductors

7 and 8 lead through the contacts 9 of the relay 10, from the arm of the rheostat 6 to a point 11 in the connection between the main and auxiliary generators, this circuit through the conductors 7 and 8 and the relay contacts 9 serving to make a shunt about the auxiliary generator, and its connected resistance, when the relay 10 pulls up. From the rheostat 6 connection is made through the coil of a load relay 12 with the electrode 13 between which and the work 2 the arc is drawn. The coil of the relay 10 is connected in shunt to the arc when the load relay 12 is energized, and in closing will not only close the contacts 9 of the shunt about the auxiliary generator, but will also close the contacts 14 of the relay 10 thereby closing the circuit of the coil of the relay 5 in parallel with the coil of the relay 10 and therefore across the arc when the load relay is closed.

With the parts as shown in the position in the drawing the rheostat 6 is adjusted to give the appropriate steadying resistance in series with the arc under working conditions and, the electrode 13 being separated from the work 2 and no arc started, the circuit is broken so that all the relays are deenergized and all of their contacts are open except those of the relay 5 which are closed. This is the non-operating condition of the apparatus. If now the electrode 13 be touched against the work, current will flow through one terminal of the main generator 1, through the auxiliary generator 3, resistance 4, contacts of the relay 5, resistance 6, the coil of the load relay 12, the electrode 13, the work 2, and the conductor 15 to the other terminal of the generator. Current will then flow in the circuit indicated. This will energize the relay 12 which will close its contacts thereby closing the circuit of the coil of the relay 10 across the arc. As soon as the operator withdraws the electrode from the work to such an extent that the drop of potential across the arc becomes sufficient, the coil of the relay 10 will become energized and close its contacts. The closing of the contacts 9 completes a low resistance shunt about that section of the circuit including the auxiliary generator 3 and which extends from the point 11 to the arm of the rheostat 6. This removes the potential of the auxiliary generator from action upon the arc and closes the circuit for that generator through the shunt mentioned, the resistance 4 and that portion of resistance of the rheostat 6 which is between the arm and the contacts of relay 5. This resistance is sufficient to hold the current through the shunt within suitable limits. The existence of this current is merely momentary, however, for the reason that the same movement of the relay 10 which closes the shunt at the contacts 9 also closes the contacts 14 thereby complet-

ing the circuit of the coil of the relay 5 which thereupon picks up and opens the branch containing the generator 3. The arc then exists under the impressed potential of the main generator 1, receiving its current through the steadying resistance of the rheostat 6. Should the operator touch the work with the electrode 13 or unduly shorten the arc so that the potential across it is sufficiently reduced, the relays 5 and 10 will let go thereby opening the shunt and placing the auxiliary generator branch in circuit. This has the effect of not only inserting the auxiliary generator in circuit, but also of inserting the resistance 4 and that portion of the resistance of rheostat 6 which is between the arm and the contacts of relay 5. This resistance is so proportioned that it will hold the current in proper limits even when the arc is short circuited by bringing the electrode against the work. Upon a proper arc being again drawn the auxiliary generator branch will be cut out as before described.

The resistance 4 may be of such value that, in conjunction with the other resistance of the circuit when the auxiliary branch is in circuit, the current flowing in the circuit under the voltage impressed by the main and auxiliary generators may be made equal to or less than the normal working current, and this resistance being cut out when the auxiliary generator is cut out, the current may actually rise when the impressed voltage is thus reduced or may remain stationary or vary in other relations according to the proportioning of the resistance.

For example: If during its operation the arc requires 200 amperes, there is a fall of potential across the arc of 25 volts and the drop of potential in the circuit connections leading to the arc at this load is 5 volts, then the main generator should have an ampere capacity of 200 amperes and a voltage of 30. If we further assume that a voltage of 25 added to the voltage of the main generator will give proper voltage for initially striking the arc and further that a current of 40 amperes is appropriate for the initial current in the starting of the arc, then the ampere capacity of the auxiliary generator may be 40 and its voltage 25, the resistance in circuit being of such value that when the auxiliary generator is in circuit the current, even under short circuit conditions, that is with the electrode against the work, will hold the current down to 40 amperes. When the auxiliary generator is cut out of circuit the resistance 4 is also cut out as well as a portion of the rheostat 6 so that while the impressed voltage is reduced by 25 volts the resistance of the circuit is so reduced that the current rises to normal value.

The striking voltage is not affected by the resistance in circuit for the reason that there is no drop of potential unless current flows.

Accordingly the full impressed voltage of the circuit is upon the electrodes prior to and at the instant of making the striking contact.

5 The main generator and the auxiliary generator may be constructed in various ways. For instance in Fig. 2 they take the form of a single machine having a double wound armature of which 16 is the commutator of the main winding and 17 is the commutator of the auxiliary winding, the two windings being then interconnected as shown in the diagram of Fig. 1. 18 represents a driving pulley.

15 In the arrangement of Fig. 3 the main and auxiliary generator windings are on separate armatures on one shaft driven by a pulley 19. The main winding having a commutator 20 and the auxiliary winding having the commutator 21.

In Fig. 4 the main and auxiliary armatures 22 and 23 are in separate machines separately driven, as by pulleys 24 and 25.

25 While the invention has been illustrated in what are considered its best applications it may have other embodiments without departing from its spirit and is not therefore limited to the structures shown in the drawings nor to the precise details of the process as herein enumerated.

30 What we claim is:—

1. In an arc system for welding, repairing and otherwise treating metals, the combination with a main generator, of an auxiliary generator, arc electrodes, conductors connecting said electrodes in circuit with said generators and means for rendering said auxiliary generator inactive.

2. In an arc system for welding, repairing and otherwise treating metals, the combination with a plurality of sources of electromotive force, arc electrodes, conductors connecting said electrodes in circuit with said sources and means for rendering one of said sources inactive.

3. In an arc system for welding, repairing, and otherwise treating metals, the combination with a main generator, of an auxiliary generator, arc electrodes, conductors connecting said electrodes in circuit with said generators and means responsive to working current for rendering said auxiliary generator inactive.

4. In an arc system for welding, repairing and otherwise treating metals, the combination with a plurality of sources of electromotive force, arc electrodes, conductors connecting said electrodes in circuit with said sources and means responsive to working current for rendering one of said sources inactive.

5. In an arc system for welding, repairing, and otherwise treating metals, the combination with a plurality of sources of electromotive force, arc electrodes, conductors

connecting said electrodes in circuit with said sources and means for successively closing a shunt about one of the said sources and then opening the circuit of the last mentioned source.

6. In an arc system for welding, repairing, and otherwise treating metals, the combination with a plurality of sources of electromotive force, arc electrodes, conductors connecting said electrodes in circuit with said sources and means responsive to working current for successively closing a shunt about one of the said sources and then opening the circuit of the last mentioned source.

7. In an arc system for welding, repairing and otherwise treating metals, the combination with a main generator of an auxiliary generator, arc electrodes, conductors connecting said electrodes in circuit with said generators, a load relay having its coil in the welding circuit, a shunt closing relay adapted to be connected across said electrodes and having its connections controlled by said load relay, a shunt about said auxiliary generator adapted to be closed by the contacts of said shunt closing relay, a relay controlling the circuit of the said auxiliary generator, the coil of the last mentioned relay being adapted to be connected across the said electrodes and having its circuit controlled by the said shunt closing relay.

8. In an arc system for welding, repairing, and otherwise treating metals, the combination with a main generator of an auxiliary generator, arc electrodes, conductors connecting said electrodes in circuit with said generators, a resistance in series with said auxiliary generator and a load relay having its coil in the welding circuit, a shunt closing relay adapted to be connected across said electrodes and having its connections controlled by said load relay, a shunt about said auxiliary generator and said resistance adapted to be closed by the contacts of said shunt closing relay, a relay controlling the circuit of the said auxiliary generator, the coil of the last mentioned relay being adapted to be connected across the said electrodes and having its circuit controlled by the said shunt closing relay.

9. The method of operating an electric welding arc circuit comprising impressing an electromotive force on said circuit, striking an arc to pass a current therethrough, and then increasing said current through said arc.

10. The method of operating an electric welding arc circuit comprising impressing an electromotive force on said circuit, striking an arc to pass a current therethrough, and then increasing said current through said arc and decreasing said electromotive force.

11. The method of operating an arc circuit for welding, repairing and otherwise

treating metals which consists in applying a high initial voltage to the circuit, and reducing the voltage without reduction of current for a given resistance of the arc.

5 12. The method of operating an arc circuit for welding, repairing and otherwise treating metals which consists in applying high initial voltage to said circuit, reducing said voltage and increasing the current for
10 a given resistance of the arc.

13. In a welding arc system the combination with arc electrodes, of a circuit connected thereto comprising means for impressing an electromotive force on said circuit to strike an arc and pass a current there-
15 through, and means for increasing said current and decreasing said electromotive force.

14. In an arc system for welding, repairing, and otherwise treating metals, the combination with means for applying a high
20 initial voltage to the circuit, electrodes, con-

ductors for connecting said means and electrodes in circuit and means for reducing the voltage without reduction of current for a given resistance of arc.

15. In an arc system for welding, repairing, and otherwise treating metals, the combination with means for applying high initial voltage to the circuit, arc electrodes, conductors for connecting said means and
30 electrodes in circuit, and means for reducing the voltage and increasing the current as the voltage is reduced for a given resistance of arc.

In testimony whereof I FRANCIS S. CALDWELL have signed this specification this 21st
35 day of October, 1916.

FRANCIS S. CALDWELL.

In testimony whereof I ALAN M. BENNETT have signed this specification, this 27th day
40 of October, 1916.

ALAN M. BENNETT.