

UNITED STATES PATENT OFFICE

2,650,977

SAFETY CONTROL FOR WELDERS

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Application August 18, 1952, Serial No. 304,982

12 Claims. (Cl. 219-4)

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This invention relates to safety control for welders.

In my Patent No. 2,494,847, issued January 17, 1950 there is disclosed a safety control system for welders, which while satisfactory requires use of an electrode carrier of special design to respond to the presence of an obstruction and initiate safety action of the control system. Such electrode carrier is relatively expensive to manufacture, and it is a primary object of the present invention to provide an improved form of safety control for welders utilizing an electrode carrier sensitive to obstruction which is simpler and less expensive to manufacture, and

Another object is to provide a control system of the aforementioned character which additionally prevents the supply of current to the welding electrodes in the event an obstruction is encountered before both electrodes engage the work piece.

Other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate preferred embodiments of the invention which will now be described in detail, it being understood that such embodiments are susceptible of various modifications in respect of details without departing from the scope of the appended claims.

In the drawings,

Figure 1 shows more or less schematically a portion of a fluid powdered welder together with an improved form of control system therefor, and

Fig. 2 shows a modified form of the control system of Fig. 1 as applied to a fluid powdered welder having supplementary magnetic force means.

Referring to Fig. 1, it shows a ram type welder having an upper welding electrode 5 and a lower welding electrode 6. Electrode 5 is supported in a carrier 7 which is movable downwardly and upwardly in a straight line through the medium of a piston (not shown) which moves in a cylinder 8. Electrode 6 is supported in a member 9 which is carried on a pivot 10. Member 9 has mounted thereon, oppositely of the side of pivot 10 on which electrode 6 is mounted, a counterweight 11. Counterweight 11 is of such a weight and its position so adjusted on member 9 that the latter normally assumes the position depicted in the drawing with its upper side engaging a stop 12, but is movable in the clockwise direction on pivot 10 out of such normal position under certain conditions when the downward force exerted on the upper end of electrode 6 exceeds a predetermined amount.

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Member 9 has rigidly attached thereto, on its lower side substantially in line with electrode 6, a member 13^a of a position lock 13 which additionally comprises an electromagnetically controlled mating member 13^b. Member 13^b, which is preferably of the form shown, is mounted on a pivot 13^c. A tension spring 13^d, secured at one end to a fixed abutment and at its other end to member 13^b, serves to bias the latter into a clockwise extreme position out of engagement with member 13^a. Member 13^b is provided with an electromagnetic operating mechanism comprising an operating winding 15, a plunger 16, and a toggle link 17 connecting plunger 16 to member 13^b. As will be understood, upon energization of winding 15 plunger 16 and link 17 are adapted to effect pivotal movement of member 13^b in the clockwise direction. If member 9 is in its aforementioned normal position, then such clockwise movement of member 13^b will ultimately bring the edge 13^e of the latter into mating engagement with the downwardly extending lug 13^f formed on member 13^a, thereby limiting such clockwise movement of member 13^b. The lower end of member 13^a is provided with a concave arcuate surface 13^g, and member 13^b on the end adjacent edge 13^e thereof is provided with a complementarily formed convex arcuate surface 13^h which is adapted to closely underlie the surface 13^g of member 13^a when said members are in the aforementioned mating engagement. Thus with members 13^a and 13^b in such mating engagement, any movement of member 9 out of its normal position in the clockwise direction is prevented and electrode 6 will accordingly be rigidly maintained in its normal position.

Adjacent edge 13^e of member 13^b the latter is provided with a V-shaped notch 13ⁱ which affords clearance for member 13^a in the event member 9 is moved in the clockwise direction when member 13^b is in its counterclockwise extreme position to thereby permit movement of member 9 at a given amount in the clockwise direction.

As hereinafter be more fully described, under normal conditions, member 9 and electrode 6 will be locked in the aforementioned normal positions thereof as an incident to movement of the lower end of electrode 5 to within a predetermined distance of the upper surface of a work piece 18, thereby insuring that electrode 6 will be held in a fixed position during a welding operation. On the other hand, should member 9 be moved in the clockwise direction out of its normal position, as an incident to application of additional force on the work piece, as for example by the oper-

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ator placing a finger or other part of his body on such work piece, locking of member 9 in its normal position will be prevented and the latter will be permitted to move said given amount in the clockwise direction.

The control system for the welder will now be described.

Movement of the aforementioned piston in cylinder 8 is effected by application of air or other fluid to the lower and upper ends thereof through the conduits 20 and 21, respectively. The means for controlling the admission and release of air in cylinder 8 from the opposite ends of the piston comprise a known form of multi-way valve 22 having an electromagnetic operating winding 22^a, and an auxiliary exhaust valve 23 having an electromagnetic operating winding 23^a interposed in an exhaust conduit 24 which connects interiorly of cylinder 8 above the upper end of the piston. In conformity with general practice valve 22 is biased to the position shown when its operating winding 22^a is deenergized, thereby affording connection of conduit 20 with an air supply conduit 25 and connection of conduit 21 with an exhaust conduit 26. The auxiliary exhaust valve 23 is closed when its operating winding 23^a is deenergized and opened when winding 23^a is energizable. In the normal position of valve 22 the piston will be driven under air pressure applied on the lower end thereof to an upper extreme position in cylinder 8, and electrode 5 and carrier 7 will assume the positions shown.

A normally open switch 27 adjustably mounted on a bracket 28 secured to a stationary abutment 29 is provided with an actuator 27^a which extends into the path of a member 30 fixed to carrier 7. Member 30 is provided with an inclined surface 30^a which is adapted to engage with actuator 27^a and operate switch 27 to circuit closed position whenever electrode 5 is moved to within the aforementioned predetermined distance of the upper surface of the work piece during downward movement of such electrode toward the work piece. Vertical adjustment of switch 27 on its bracket 28 permits adjustment of such distance as desired, and in accordance with the thickness of the work pieces handled. Switch 27 is preferably of the sensitive snap action type.

The movable contactor of switch 27 is connected in circuit to a line L¹ of a power supply, which additionally comprises the line L². The stationary contact of switch 27 is connected in series with operating winding 15 of the electromagnetic operating mechanism of member 13^b to line L². A manually operable switch 31 is connected at one terminal thereof to line L¹ and has its other terminal connected in series with operating winding 15 to line L². Closure of switch 31 permits winding 15 to be energized and thus afford locking of member 9 and electrode 6 in position during setting-up operations on the welder. Switch 31 is maintained open during normal welding operations, and energization of winding 15 will be subject solely to closure of switch 27 as aforesaid.

A normally open switch 32, of the same type as switch 27, is stationarily mounted with its actuator 32^a just engaging the upper edge of member 9 when the latter is in its aforementioned normal position. Upon clockwise movement of member 9 actuator 32^a is moved inwardly of switch 32 to operate the latter to circuit closed position. The movable contactor of switch 32 is connected to line L¹ and the stationary contact

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thereof is connected in series with the operating winding 33^a of a relay 33 to line L².

Relay 33 is additionally provided with normally closed contacts 33^b, normally open contacts 33^c, a latch 33^d and an electromagnetic latch releasing winding 33^e. Winding 33^e is connectable at one end to line L¹ through closure of a normally open manual switch 34 and is connected at its other end to line L². It will be apparent that upon energization of winding 33^a the relay will be actuated to open its contacts 33^b and close its contacts 33^c, and will be retained in such actuated position by latching operation of latch 33^d pending energization of winding 33^e by closure of switch 34 to release said latch.

A switch 35, which in practice is preferably one of a foot operated type normally biased to open circuit position, is connected through one terminal thereof to line L¹ and is connected through its other terminal in series with contacts 33^b of relay 33 and operating winding 22^a of valve 22 to line L². It will be apparent that closure of switch 35 will effect energization of winding 22^a to operate valve 22 to the position wherein air is supplied to the upper end of the piston through conduit 21 and air in cylinder 8 below said piston is exhausted through conduits 20 and 26.

Operating winding 23^a of auxiliary exhaust valve 23 has one end thereof connectable to line L¹ through normally open contacts 33^c of relay 33 and its other end is connected to line L². Winding 23^a will thus be energized to open valve 23 whenever relay 33 operates to close its contacts 33^c.

The welder is provided with a welding current controller, schematically depicted at 36, which may be of any preferred type. Controller 36 is shown connected to lines L¹ and L² on its input side and connected on its output side in circuit with the primary winding 37^a of a welding transformer 37. Transformer 37 has a secondary winding 37^b in circuit with welding electrodes 5 and 6.

Operation of controller 36 to supply current to welding transformer 37 is subject to operation of a pressure switch 38, a manual switch 39 and a switch 40. Switch 38 may be assumed to be a well known type of pressure switch, which through the medium of its connection with conduit 21 is subjected to the pressure of air obtaining in cylinder 8 above the upper end of the piston, and which is adapted to close when such pressure attains a predetermined value. One terminal of switch 38 is connected directly to controller 36 while the other terminal thereof is connected in series with switch 39 to the movable contactor of switch 40. Switch 40, which has its stationary contact connected to controller 36, is a normally closed switch preferably of the same type as switches 27 and 32. Switch 40 is stationarily mounted adjacent member 13^b of the aforesaid position lock, in such a manner that its actuation 40^a is adapted to be moved inwardly to operate switch 40 to open circuit position when member 13^b assumes its aforementioned counterclockwise extreme position. It may be assumed that with switch 39 closed, that operation of controller 36 to supply welding current is effected by operation of switches 38 and 40 to circuit closing positions. Such arrangement insures that the initial electrode pressure on the work piece 13 attains a desired value and that electrode 6 is locked in working position before welding current can be supplied. Opening of switch 39 insures against operation of con-

troller 36 during setting up operations on the welder.

The operation of the welder together with its control system will now be described.

Operation of the welder is initiated by closure of switch 35. Winding 22^a of valve 22 is thereby energized and the latter thus assumes the position wherein air under pressure is supplied to cylinder 8 above the piston and air is exhausted from the cylinder below the piston. As a result, carrier 7 and electrode 5 move downwardly toward the work piece 18.

Assuming that counterweight 11 has been properly adjusted for the normal weight of work piece 18 and that no obstruction is over such work piece as would cause member 9 to move clockwise, then when electrode 5 closely approaches the upper surface of the work piece actuator 27^a will be engaged by surface 30^a of member 30 of carrier 7 to actuate switch 27 to closed circuit position. As a result winding 15 becomes energized and member 13^b is instantly moved into mating locking engagement with member 13^a and consequently member 9 and electrode 6 are thus locked in position. Thereafter electrode 5 engages with work piece, and when the pressure in cylinder 8 above the upper end of the piston builds up to a predetermined value, corresponding to a desired initial electrical pressure on the work piece, switch 38 closes completing circuit through the then closed switch 39 and switch 40 which previously closed by movement of member 13^b into locking engagement with member 13^a. Consequently controller 36 then operates to supply welding current, to welding transformer 37.

After completion of a welding operation on the work 18, the return of the welder to its normal position is effected by release of switch 35. Release of switch 35 causes deenergization of winding 22^a of valve 22 and the latter then returns to its normal position wherein air is exhausted from cylinder 8 above the upper end of the piston through conduits 21 and 26 and air is supplied under pressure from conduit 25 through conduit 20 into the cylinder below the lower end of the piston. Consequently carrier 7 and electrode 5 are driven upwardly into their normal positions and maintained in such positions pending reclosure of switch 35. Carrier 7 in moving upwardly to its normal position disengages member 30 from actuator 27^a of switch 27 and the latter returns to its normally open position, thereby effecting deenergization of operating winding 15. As a result member 13^b of the position lock returns to its counterclockwise position under the bias of spring 13^d and in so doing causes switch 40 to be actuated to its open circuit position. Switch 38 may be assumed to reopen due to release of air in cylinder 8 above the upper end of the piston.

Now let it be assumed that the welder and control system is in the condition shown, that switch 35 is closed, that carrier 7 and electrode 5 are thus moved downwardly toward work 18, and that an obstruction is inadvertently placed on the work piece. If member 9 has been properly balanced by correct positioning of counterweight 11 thereon, then the added force of such obstruction on the work piece will cause member 9 to pivotally move in the clockwise direction on pivot 10. A slight degree of such movement of member 9 causes actuation of switch 32 to its circuit closed position thereby effecting energization of operating winding 33^a of relay 33. Relay 33 thus operates to a position effecting opening of contacts 33^b and closing of contacts 33^c and

wherein it is positively latched by its latch 33^d. As a result of opening of contacts 33^b winding 22^a of valve 22 is deenergized, thereby effecting resetting of valve 22 to the position wherein air is exhausted from cylinder 8 above the upper end of the piston and air is supplied under pressure into the cylinder below the lower side of the piston to effect drive of carrier 7 and electrode 5 upwardly to their normal positions. Closure of contacts 33^c of relay effects energization of operating winding 23^a of auxiliary exhaust valve 23 and the latter thereupon opens to insure rapid exhaustion of air in cylinder 8 above the upper end of the piston thereby insuring rapid return of carrier 7 and electrode 5 to their normal positions.

It will be apparent that with relay 33 latched in actuated position that said relay cannot return to its normal position even though winding 33^a is deenergized as an incident to return of switch 32 to open circuit position following return of member 9 to its normal position. Thus while relay 33 is latched in actuated position, the welder cannot be again reoperated by reclosure of switch 35 due to the contacts 33^b of relay 33 being in open position. Following clearing of the obstruction, relay can be readily reset to its normal position by closure of switch 34 which effects energization of latch release winding 33^a to afford release of latch 33^d.

The last described functioning of the control system and welder insures against injury to the operator should he negligently get a portion of his person in line with the electrode 5 over the work piece. It will be observed that yielding of member 9 together with the rapid return of electrode 5 and carrier 7 to their normal positions insures against injury.

It will be observed that in order to insure such safety action that the switch 32 must be actuated to closed circuit position before switch 27 is actuated to closed circuit position. Thus care should be exercised in setting the position of switch 27 on bracket 28 so that switch 27 will not be actuated by member 30 until the lower end of electrode 5 closely approaches the work, and the position of switch 27 should be changed accordingly wherein the welder is set up to handle work of different thickness than previously handled. It is also important that the assembly comprising member 9, electrode 6 and member 13^a of the lock be carefully balanced by appropriate selection of the weight of counterweight 11 and its positioning on member 9 in relation to the normal weight of the work 18 bearing downward on the electrode 6 so that such assembly will move clockwise as aforescribed upon application of but a slight additional downward force thereon to the right of pivot 10.

Auxiliary exhaust valve 23 and the parts associated therewith, including contacts 33^c of relay 33, may be omitted if valve 22 is of such character that it will provide for rapid exhaustion of air or other fluid at a rapid rate, but the use of such auxiliary exhaust valve is deemed desirable from the added safety that its use entails.

Referring to Fig. 2, it shows a ram type welder fitted with additional magnetic force applying means, such as disclosed in the Cox et al. Patent No. 2,477,117 and in my application Serial No. 229,096, filed May 31, 1951, together with a modified form of control system therefor affording safety operation. The control system of Fig. 2 omits the auxiliary exhaust valve 23, conduit 24, switch 32, relay 33 and switch 34 disclosed in connection with the embodiment of Fig. 1. Other

parts of the welder and the control system of Fig. 2 which are the same as that of the embodiment of Fig. 1 bear the same reference numerals.

The welder of Fig. 2 is provided with an upper electrode carrier 45 which has secured therein an upper welding electrode 46. Carrier 45 in moving upwardly and downwardly with respect to the work 18 moves within a clearance opening 47^a formed in a stationarily mounted magnet 47 which may be assumed to have an energizing coil (not shown). An armature 48 rigidly secured to carrier 45 is adapted to be moved into close proximity with the upper end of magnet 47 when carrier 45 and electrode move into their lower extreme positions. It is necessary for proper functioning of the magnetic force applying means that armature 48 approach magnet 47 not closer than a predetermined minimum distance, and consequently the downward limit of travel of carrier 45 and electrode 46 will be accordingly fixed.

The aforementioned energizing coil of magnet 47 is connected in circuit with electrode 46 and one end of a secondary winding 49^b of a welding transformer 49 which also has a primary winding 49^a connected to the output side of welding current controller 36. Thus when welding circuit is supplied to transformer 49, a portion of the current supplied to electrodes 6 and 46 flows through the energizing coil of magnet 47, which thereupon attracts armature 48 to effect additional force exerted by electrode 46 on work 18 during or shortly after the flow of welding current there-through, as is more fully explained in the aforementioned Cox et al. patent.

In view of the omission of relay 33 in the control system of Fig. 2, switch 35 is connected in circuit across lines L¹ and L² in series with operating winding 22^a of valve 22. A member 50 secured to armature 48 is adapted to engage on an inclined surface 50^a thereof with actuator 27^a of switch 27 and actuate the latter to closed circuit position when electrode 46 moves to within a short distance of the upper surface of work 18.

The control system of Fig. 2 under normal operating conditions functions in the same manner as aforescribed in connection with Fig. 1 to provide the same kind of welder operations. If an obstruction is placed over the work piece 18, member 9 pivots clockwise, but such movement does not result in return of carrier 45 and electrode 46 to their normal extreme conditions as is the case with the welder of Fig. 1. Inasmuch as the downward travel of carrier 45 and electrode 46 is definitely limited, due to the fact that a minimum spacing must be maintained between armature 48 and magnet 47, return of carrier 45 and electrode 46 is not required to provide adequate safety. The yielding movement of member 9 in the clockwise direction is sufficient to insure against injury to the operator.

I claim:

1. In a powered electric welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable in reverse directions to move said one electrode toward or away from the other electrode, power responsive means for moving said carrier in said reverse directions, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated

locking means energizable to lock the last mentioned carrier in said one extreme position when in that position, and control means for said locking means operable in response to movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its said one extreme position if then in that position.

2. In a powered electric welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable in reverse directions to move said one electrode toward or away from the other electrode, power responsive means for moving said carrier in said reverse directions, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated locking means energizable to lock the last mentioned carrier in said one extreme position when in that position, control means for said locking means operable in response to movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its said one extreme position if then in that position, means including a controller for supplying said electrodes with welding current, and control means responsive to the aforementioned operation of said locking means and to application of a predetermined degree of electrode pressure on the work to render said controller operative to supply said electrodes with welding current.

3. In a powered electric welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable in reverse directions to move said one electrode toward or away from the other electrode, power responsive means for moving said carrier in said reverse directions, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated locking means energizable to lock the last mentioned carrier in said one extreme position when in that position, and control means for said power responsive means and said locking means including means responsive to movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its one extreme position if then in that position and further including means responsive to movement of said last mentioned carrier out of its one extreme position to effect powered movement of said first mentioned carrier in a direction to separate the electrodes.

4. In a powered electric welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable in reverse directions to move said one electrode toward or away from the other electrode, power responsive means for moving said carrier in said reverse directions, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated locking means energizable to lock the last mentioned carrier in said one extreme position when in that position, control means for

said locking means including an electric switch operable as a result of movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its one extreme position if then in that position, and control means for said power responsive means including a second electric switch operable upon movement of said last mentioned carrier out of its one extreme position to effect powered movement of said first mentioned carrier in a direction to separate the electrodes.

5. In a powered electric welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable in reverse directions to move said one electrode toward or away from the other electrode, power responsive means for moving said carrier in said reverse directions, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated locking means energizable to lock the last mentioned carrier in said one extreme position when but only when it is in such position, control means for said power responsive means and said locking means including means responsive to movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its said one extreme position if then in that position and further including means responsive to movement of said last mentioned carrier out of its normal position to effect powered movement of said first mentioned carrier in a direction to separate the electrodes, means including a controller for supplying said electrodes with welding current, and control means responsive to the aforementioned operation of said locking means and to application of a predetermined degree of electrode pressure on the work to render said controller operative to supply said electrodes with welding current.

6. In a fluid powered welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable in reverse directions to move said one electrode toward or away from the other electrode, fluid power responsive means subject to manual control to selectively move said carrier to a normal extreme position or in the opposite direction toward the other electrode, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, locking means including electro-responsive operating means energizable to lock the last mentioned carrier in said one extreme position when in that position, an electroresponsive relay which when energized effects powered movement of the first mentioned carrier to its normal extreme position, an electric switch operable as a result of movement of said first mentioned carrier to within a predetermined distance of the work to energize said operating means and effect locking of said last mentioned carrier in said one position if then in that position, and a second electric switch operable in responsive to movement of said last mentioned carrier out of its said one extreme position to energize said relay.

7. In a powered electric welder, in combina-

tion, a pair of welding electrodes, a carrier for one of said electrodes movable to a normal extreme position separating the electrodes and movable to an opposite extreme position for welding, power responsive means for moving said carrier between said extreme positions, magnetic force means comprising a magnet having an energizing coil in circuit with said electrodes and an armature on said carrier attractable by said magnet when said carrier is in its opposite extreme position to afford application of additional force on the work in proportion to the welding current, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated locking means energizable to lock the last mentioned carrier in its said one extreme position when in that position, and control means for said locking means operable in response to movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its said one extreme position if then in that position.

8. In a powered electric welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable to a normal extreme position separating the electrodes and movable to an opposite extreme position for welding, power responsive means for moving said carrier between said extreme positions, magnetic force means comprising a magnet having an energizing coil in circuit with said electrodes and an armature on said carrier attractable by said magnet when said carrier is in its opposite extreme position to afford application of additional force on the work in proportion to the welding current, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated locking means energizable to lock the last mentioned carrier in its said one extreme position when in that position, and control means for said locking means including an electric switch operable as a result of movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its said one extreme position if then in that position.

9. In a powered electric welder, in combination, a pair of welding electrodes, a carrier for one of said electrodes movable to a normal extreme position separating the electrodes and movable to an opposite extreme position for welding, power responsive means for moving said carrier between said extreme positions, magnetic force means comprising a magnet having an energizing coil in circuit with said electrodes and an armature on said carrier attractable by said magnet when said carrier is in its opposite extreme position to afford application of additional force on the work in proportion to the welding current, a pivotally movable carrier for said other electrode normally biased to one extreme position in which the latter electrode is in line with said one electrode and being movable out of said one extreme position by application of force in addition to that exerted by the work, power operated locking means energizable to lock the last mentioned carrier in its said one extreme position

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when in that position, control means for said locking means operable in response to movement of the first mentioned carrier to within a predetermined distance of the work to effect locking of said last mentioned carrier in its said one extreme position if then in that position, means including a controller for supplying said electrodes with welding current, and control means responsive to the aforementioned locking operation of said locking means and to application of a predetermined degree of electrode pressure on the work to render said controller operative to supply said electrodes with welding current.

10. In combination, a pivotally supported electrode carrier member, a stop in line with said member to limit its movement in one direction, biasing means associated with said member normally biasing the latter into engagement with said stop, said member being movable away from said stop upon application of a force preponderating the effect of said biasing means, and locking means including power responsive operating means energizable to lock said member in engagement with said stop when in that position.

11. In combination, a pivotally supported electrode carrier member, a stop in line with said

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member to limit its movement in one direction, a weight adjustably mounted on said member acting to bias said member into engagement with said stop, said member being movable away from said stop upon application of a force preponderating the biasing effect of said weight, and locking means including power responsive operating means energizable to lock said member into engagement with said stop if then in that position.

12. In combination, electrode carrier member, pivotal bearing support means for said member, a stop in line with said member to limit movement of said member in one direction, a weight adjustably mounted on said member on the opposite side of its pivot support from that on which the electrode is mounted and acting to bias said member into engagement with said stop, said member being movable away from said stop upon application of a force preponderating the biasing effect of said weight, and locking means including electroresponsive operating means energizable to lock said member in engagement with said stop when in that position.

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No references cited.