United States Patent

Viola et al.

[15] **3,703,621**

[45] **Nov. 21, 1972**

[54] **RECIPROCATING FRUSTO-CONICAL PLUG SWITCH CONTACT AND ASSEMBLY**

[72] Inventors: **Ronald J. Viola**, Fort Lee; **Lawrence V. Keeney**, Saddle Brook, both of N.J.

[73] Assignee: **Rapid Electric Co., Inc.**, Bronx, N.Y.

[22] Filed: **July 21, 1971**

[21] Appl. No.: **164,716**

[52] **U.S. Cl.** .....**200/163**, 200/16 E, 200/146 A

[51] **Int. Cl.**.....**H01h 1/38**, H01h 15/10

[58] **Field of Search**.....200/16 A, 16 B, 16 E, 162, 200/163, 166 B, 166 BB, 166 BH, 146 R, 146 A

[56] **References Cited**

UNITED STATES PATENTS

3,639,704	2/1972	Alinder	200/1 V
1,235,515	7/1917	Chrisman	200/16 E UX
797,065	8/1905	Luther	200/146 A X
592,497	10/1897	Scott	200/146 A
1,169,089	1/1916	Lawton et al.	200/163 X

FOREIGN PATENTS OR APPLICATIONS

117,418	7/1918	Great Britain	200/16 B

Primary Examiner—J. R. Scott

Attorney—Sherman and Shalloway

[57] **ABSTRACT**

A reversing switch for reversing the supply of current to a load from a DC source including a pair of stacked contact structures, each of which defines two electrical switches operated by means of conical connectors movable within conical bores centered at insulating layers in the stacked structures whereby the direction of current supplied to the load is controlled by the operation of the electrical switches.

19 Claims, 5 Drawing Figures

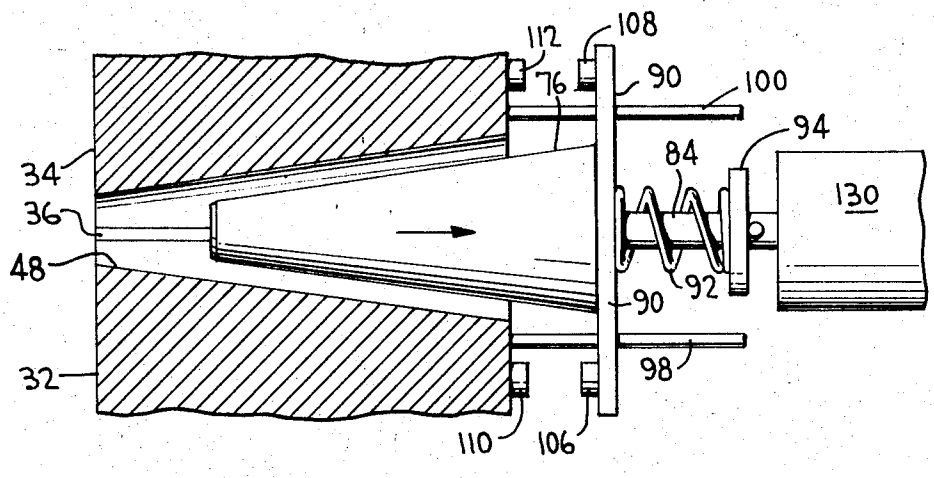


FIG. 1

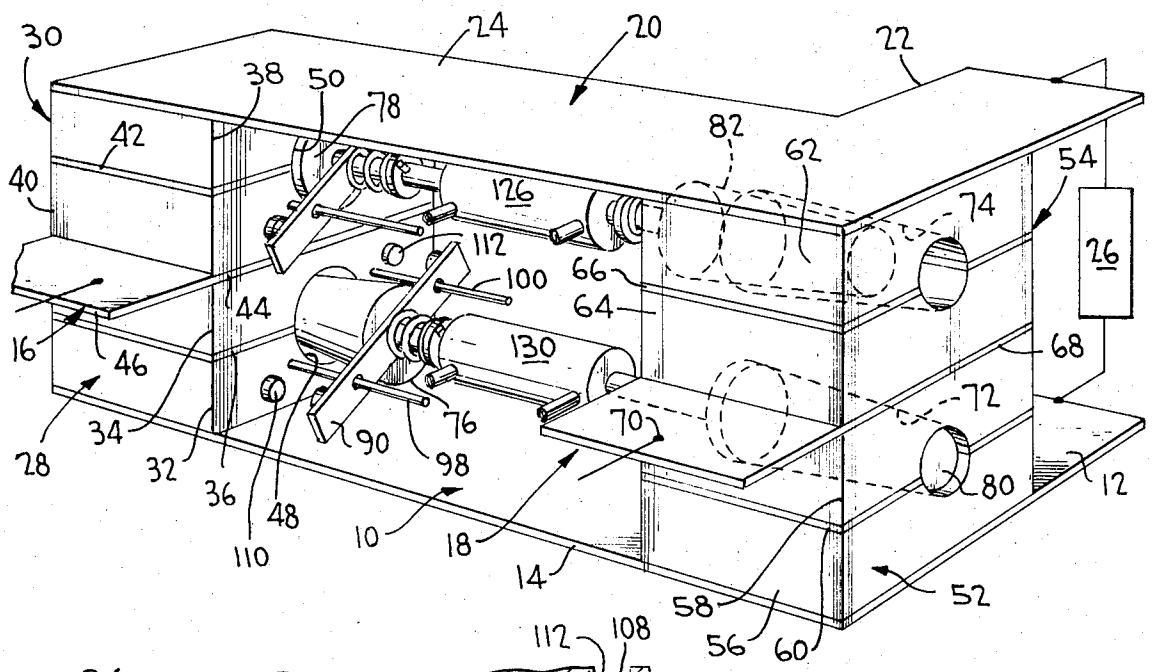


FIG. 2

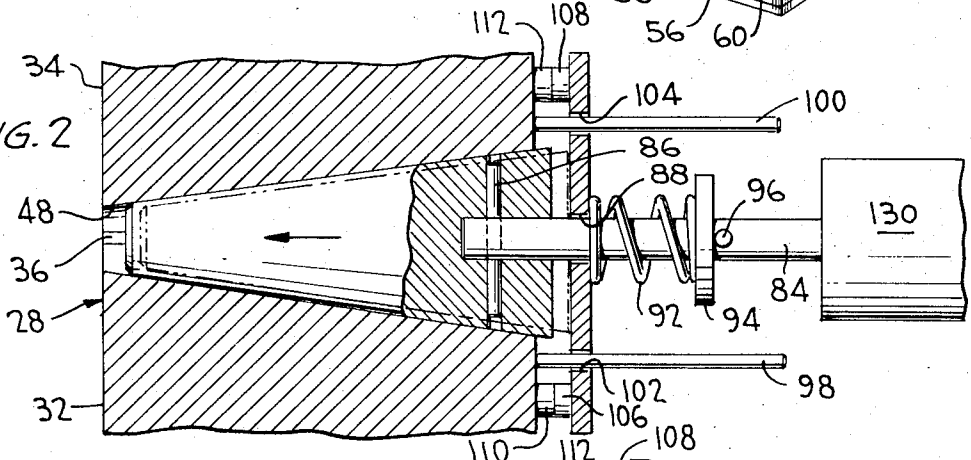
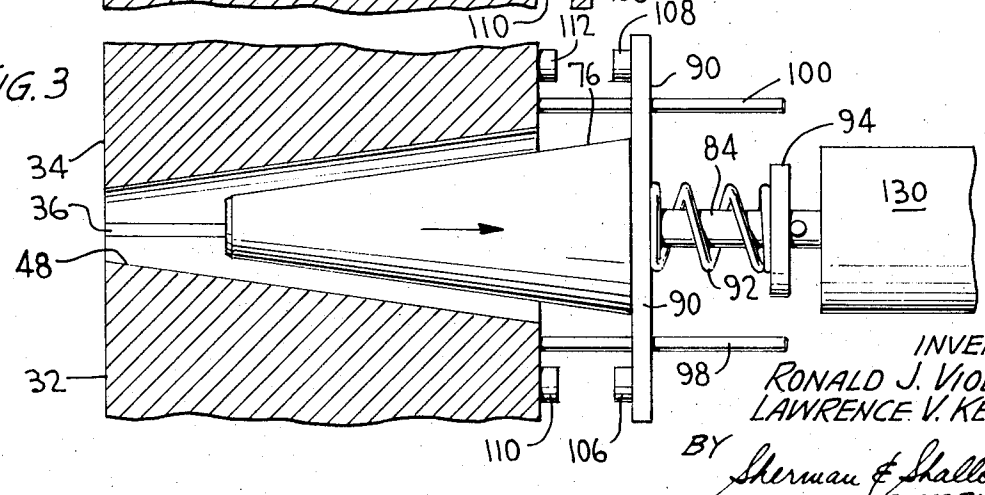


FIG. 3



INVENTORS,
RONALD J. VIOLA
LAWRENCE V. KEENEY
BY Sherman & Shalloway
ATTORNEYS

FIG 4

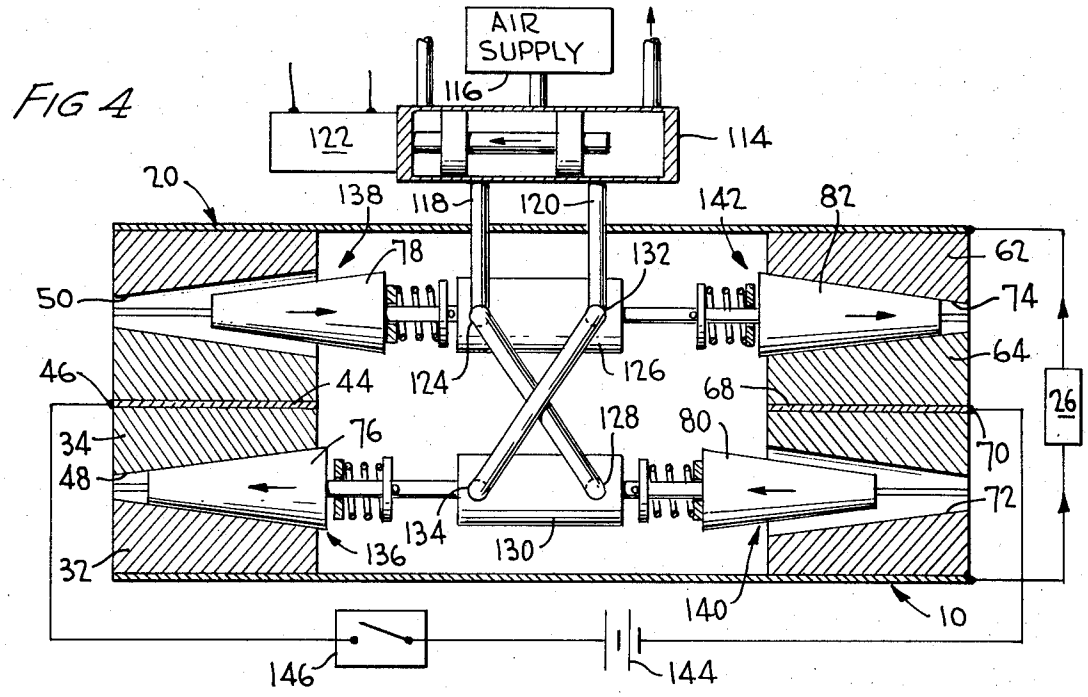
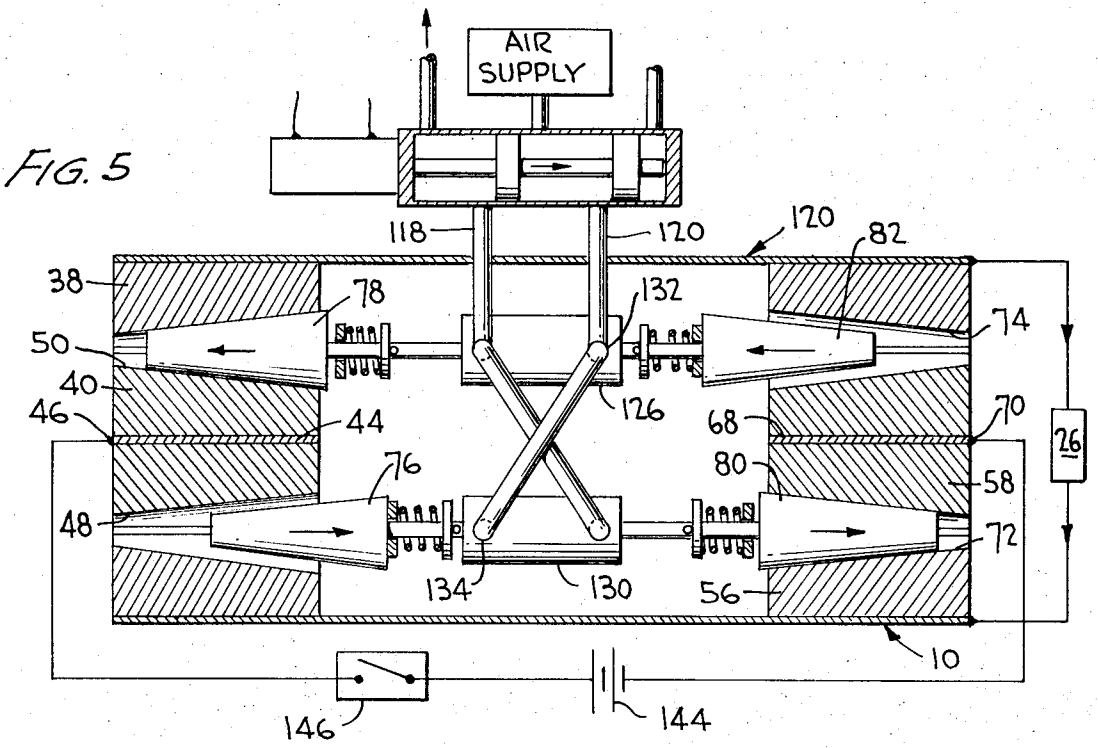


FIG. 5



INVENTORS,
RONALD J. VIOLA
LAWRENCE V. KEENEY
BY Sherman & Shalloway
ATTORNEYS

RECIPROCATING FRUSTO-CONICAL PLUG SWITCH CONTACT AND ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention pertains to electrical switches and, more particularly, to electrical switches for reversing the current supplied to a load from a DC source.

2. Discussion of the Prior Art

Reversing switches for reversing the current through a load have many uses in industry, including, among others, electroplating, motor control, and welding. A primary use for reversing switches is in the plating of metals, wherein it has been found that periodic reversing of current during the plating or depositing of metal has the advantage of providing smoother deposits with higher densities and greater uniformity of thickness than can be obtained during continuous current plating. Another advantage of periodic current reversing is that bright, high-tensile-strength deposits can be obtained without requiring organic addition agents.

In the past, switches for reversing current through a load have been constructed so as to be manually operated such as by simultaneously moving a pair of blade switches. Such manually operated switches, while having the advantages of being simple in construction and inexpensive, have the disadvantages of being dangerous and not being susceptible for automatic and/or accurate periodic operation. In order to overcome the disadvantages of manually operated reversing switches, automatic reversing switches have been constructed; however, such automatic reversing switches have suffered the disadvantages of being extremely expensive, overly complex in structure, and relatively bulky and unwieldy. It will be appreciated, of course, that reversing switches must normally be capable of handling currents up to 12,000 amperes, and such requirements, coupled with the need for automatic operation and a great number of switching operations over the lifetime of the switches, have rendered known automatic switches undesirable.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to construct an automatic switch for reversing current through a load that is small and compact, is capable of handling large currents, may be inexpensively produced, and has an extremely long lifetime.

The present invention is generally characterized in an electrical switch for reversing the current supplied to a load from a DC source including a first terminal, a first contact block and a second contact block disposed in stacked relation with the first and second contact blocks on opposite sides of the first terminal and electrically insulated therefrom; a second terminal, a third contact block and a fourth contact block disposed in stacked relation with the third and fourth contact blocks on opposite sides of the second terminal and electrically insulated therefrom; the first and second terminals adapted to be connected with opposite terminals of the DC source, the first and third contact blocks being interconnected and adapted to be connected with a first terminal of the load, and the second and fourth contact blocks being interconnected and

adapted to be connected with a second terminal of the load; and control means for connecting the first terminal with the first contact block and the second terminal with the fourth contact block to supply current to the load in a first direction and for connecting the first terminal with the second contact block and the second terminal with the third contact block to supply current to the load in a second direction opposite to the first direction.

Another object of the present invention is to construct an electrical switch utilizing a stacked contact structure having an insulating layer therein and a conical bore centered at the insulating layer, and a conical connector movable within the bore.

A further object of the present invention is to construct an electrical switch having an arc suppressing assembly to prevent arcing during switching operation.

The present invention has another object in that an electrical reversing switch utilizes stacked contact structures having conical bores therein and conical connectors having mating configurations with the bores to assure continuous smooth contact with the inner surface of the bores to permit the reversing switch to be relatively small while handling large currents.

Some of the advantages of the present invention over the prior art are that electrical switches of the present invention are small and compact, have relatively few moving parts, are inexpensive, and can handle large currents.

Other objects and advantages of the present invention will become apparent from the following description of the preferred embodiment taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a reversing switch constructed in accordance with the present invention.

FIG. **2** is a broken elevation partly in section of a component switch assembly of the reversing switch of FIG. **1** in a closed state.

FIG. **3** is a broken elevation partly in section of a component switch assembly of the reversing switch of FIG. **1** in an open state.

FIGS. **4** and **5** are diagrammatical side elevations of the reversing switch of FIG. **1** in opposite states.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A reversing switch constructed in accordance with the present invention is illustrated in FIG. **1** and includes an L-shaped conductive connecting member **10** having a short leg **12** and a long leg **14**. A stacked contact structure **16** is secured to the free end of leg **14**, and a stacked contact structure **18** is secured to the corner of member **10** where legs **12** and **14** meet. An L-shaped conductive connecting member **20** is secured at its free end to contact structure **16** and has a short leg **22** and a long leg **24** which meet at an area secured to contact structure **18**. Conductive members **10** and **20** are identical in structure and configuration and are disposed in parallel relation as spaced by contact structures **16** and **18**. Legs **12** and **22** of conductive members **10** and **20** extend beyond contact structure **18** and form terminals for connection with a load **26**.

Contact structure 16 is constructed to provide a set of contacts generally indicated at 28 and a set of contacts generally indicated at 30. The stacked contact structure 16 includes a block of conductive material 32 secured to conductive member 10 and insulated from a similar block of conductive material 34 by a layer of electrically insulating material 36. A block of conductive material 38 is secured to conductive member 20 and insulated from a similar block of conductive material 40 by a layer of electrically insulating material 42, and blocks 34 and 40 are interconnected by a conductive member 44 which extends beyond the stack structure to define a supply terminal 46.

Blocks 32 and 34 form the set of contacts 28; and, similarly, blocks 38 and 40 form the set of contacts 30. Truncated conical bores 48 and 50 are disposed in the stacked structure of contact sets 28 and 30 centered along insulating layers 36 and 42, respectively. The bores 48 and 50 extend entirely through the stacked contact structure 16 and taper from large diameter ends at the inner surface of the stacked structure to smaller diameter ends at the outer surface thereof. The axes of bores 48 and 50 are aligned with the planes of insulating layers 36 and 42, respectively, such that the stacked structure of the contact sets has a symmetrical configuration about the plane of the insulating layers.

Contact structure 18 is constructed similarly to stacked structure 16 to provide a set of contacts generally indicated at 52 and a set of contacts generally indicated at 54. The stacked contact structure 18 includes a block of conductive material 56 secured to conductive member 10 and insulated from a similar block of conductive material 58 by a layer of electrically insulating material 60. A block of conductive material 62 is secured to conductive member 20 and insulated from a similar block of conductive material 64 by a layer of electrically insulating material 66, and blocks 58 and 64 are interconnected by a conductive member 68 which extends beyond the stack structure to define a supply terminal 70.

Blocks 56 and 58 form the set of contacts 52; and, similarly, blocks 62 and 64 form the set of contacts 54. Truncated conical bores 72 and 74 are disposed in the stacked structure of contact sets 52 and 54 centered along insulating layers 60 and 66, respectively. The bores 72 and 74 extend entirely through the stacked contact structure 18 and taper from large diameter ends at the inner surface of the stacked structure to smaller diameter ends at the outer surface thereof. The axes of bores 72 and 74 are aligned with the planes of insulating layers 60 and 62, respectively, such that the stacked structure of the contact sets has a symmetrical configuration about the insulating layers.

Each set of contacts 28, 30, 52 and 54 has a connector assembly associated therewith to selectively provide electrical connections between the contact blocks, and the combination of each set of contacts with each connector assembly defines a component switch assembly such that the reversing switch includes two pairs of electrical switches. The connector assemblies include conical connectors 76, 78, 80, and 82 adapted to be movable within bores 48, 50, 72, and 74, respectively; and each of the connector assemblies also includes an arc suppressing assembly. Since the connector and arc suppressing structure is identical for all of the connector assemblies, this structure will be described in detail only with respect to the switch assembly including the set of contacts 28, as illustrated in FIGS. 2 and 3.

Conical connector 76 has a configuration to mate with conical bore 48 and is supported at the end of a piston rod 84 which extends into the large diameter end of the conical connector by means of a transversely extending pin 86. Piston rod 84 extends through an aperture 88 in a conductor bar 90, and a coil spring 92 is mounted in compression between conductor bar 90 and a plate 94 which is held in position on piston rod 84 by means of a protruding stop 96. A pair of angularly offset guide pins 98 and 100 extend from contact blocks 32 and 34, respectively, and guide pins 98 and 100 are received in apertures 102 and 104 in the ends of conductor bar 90 such that the conductor bar is longitudinally slidable thereon at an angular position. Conductor bar 90 carries a pair of arc suppressing contacts 106 and 108 at the ends thereof, which contacts are adapted to engage a pair of arc suppressing contacts 110 and 112 supported on contact blocks 32 and 34, respectively, in angularly offset relation corresponding to guide pins 98 and 100 such that contacts 110 and 112 are positioned in alignment with contacts 106 and 108.

As is best illustrated in FIGS. 4 and 5, the switch assemblies are controlled by a pneumatic control system including a valve 114 receiving air under pressure from a supply 116. Valve 114 has a movable piston therein to control the supply of air from 116 to either an outlet 118 or an outlet 120 under the control of a solenoid 122. Outlet 118 communicates with an inlet 124 of a double-acting pneumatic cylinder 126 and an inlet 128 of a double-acting pneumatic cylinder 130, and outlet 120 communicates with an inlet 132 of cylinder 126 and an inlet 134 of cylinder 130.

The reversing switch essentially includes a pair of single pole, double throw switches made up of contact structures 16 and 18 and connectors 76, 78 and 80, 82, respectively. Each single pole, double throw switch includes a pair of switch assemblies indicated generally at 136, 138 and 140, 142 in FIGS. 4 and 5 with switch assemblies 136 and 140 simultaneously controlled by cylinder 130 and switch assemblies 138 and 142 simultaneously controlled by cylinder 126. That is, the piston rods supporting connectors 76 and 80 are mechanically linked such that connectors 76 and 80 are moved in the same direction at the same time; and, similarly, the piston rods supporting connectors 78 and 82 are mechanically linked such that connectors 78 and 82 are moved in the same direction at the same time.

In operation, a power supply 144, such as a DC source, is connected to input terminals 46 and 70 through a switch 146 which, when closed, connects the positive terminal of the source to supply terminal 46 and the negative terminal of the source to supply terminal 70. The reversing switch has two states, as illustrated in FIGS. 4 and 5, wherein current through load 26 is conducted in opposite directions as indicated by arrows in FIGS. 4 and 5.

The reversing switch is illustrated in a first state in FIG. 4 with solenoid 122 energized to move the piston in valve 114 to the left to permit air supply 116 to communicate with inlet 124 of cylinder 126 and inlet 128 of

cylinder 130. Connectors 78 and 82 are accordingly moved to the right such that connector 78 is withdrawn from bore 50 and connector 82 is moved into bore 74 to contact the inner surface thereof, and connectors 76 and 80 are moved to the left such that connector 78 is moved into bore 48 to contact the inner surface thereof and connector 80 is withdrawn from bore 72. Thus, switch assemblies 138 and 140 are open, and switch assemblies 136 and 142 are closed to permit current flow from the positive terminal of source 144 through terminal 46, conductive member 44, contact block 34, connector 76, contact block 32, connecting member 10, load 26, connecting member 20, contact block 62, connector 82, contact block 64, conductive member 68, and terminal 70 to the negative terminal of source 144.

In order to place the reversing switch in the second state, illustrated in FIG. 4, solenoid 122 is deenergized to move the piston in valve 114 to the right to permit air supply 116 to communicate with inlet 132 of cylinder 126 and inlet 134 of cylinder 130. Connectors 78 and 82 will accordingly be moved to the left and connectors 76 and 80 will be moved to the right such that connectors 76 and 82 are withdrawn from bores 48 and 74 and connectors 78 and 80 are moved into bores 50 and 72. Before connectors 78 and 80 are moved sufficiently to engage the inner surfaces of bores 50 and 72, arc suppressing contacts 106 and 108 carried on conductor bar 90 will engage arc suppressing contacts 110 and 112, respectively, in each of switch assemblies 138 and 140 such that current initially flows through the arc suppressing assembly between contact blocks to prevent arcing when the reversing switch changes states. That is, current will initially bypass the connector by flowing through the arc suppressing contacts and the conductor bar in order to prevent arcing when the connectors are close to the inner surface of the bores. Springs 92 permit movement of conductor bars 90 to enable full movement of connectors 78 and 80 to contact the inner surfaces of bores 50 and 72. Thus, in the second state, switch assemblies 136 and 142 are open, and switch assemblies 138 and 140 are closed to permit current flow from the positive terminal of source 144 through terminal 46, conductive member 44, contact block 40, connector 78, contact block 38, connecting member 20, load 26, connecting member 10, contact block 56, connector 80, contact block 58, conductive member 68, and terminal 70 to the negative terminal of source 144.

Of course, when the reversing switch is returned to the first state, the arc suppressing assemblies operate in the same manner as above described to prevent arcing. Furthermore, upon energization of the solenoid 122 to return the reversing switch to the state illustrated in FIG. 4, arc suppressing contacts 106, 110 and 108, 112 will be maintained in contact as the connectors are moved out of the bores to prevent damage to the contact blocks and the connectors from arcing which would normally occur upon opening of the switch assemblies. Thus, it will be appreciated that the contact and disengagement of the connectors in the bores always occurs in such a manner so as not to constitute a making or breaking of a circuit since the arc suppressing contacts will be in engagement before the connectors engage the inner surface of the bores during closing of a switch and after the connectors move out of contact with the bores during opening of a switch. That is, the arc suppressing contacts are positioned to be in engagement when the conical connectors are within arcing distance of the inner surfaces of the conical bores. The time during which any substantial current flows through the arc suppressing contacts is very short; and, therefore, the arc suppressing contacts may be small and may be constructed of a material such as a silver-tungsten composition having a high melting temperature.

While a specific control system has been illustrated in FIGS. 4 and 5, it will be appreciated that other control systems could be utilized with the present invention. For example, cylinders 126 and 130 could be replaced by solenoids with armatures supporting the connectors such that the connectors are moved within the bores in the same manner as above described. Of course, suitable control circuitry must be provided to provide proper operation of the solenoids. Similarly, it will appreciated that the control such as by means of solenoid 122 may be designed in any desirable manner relative to the state of the reversing switch and the energization of solenoid 122, and any suitable switch such as a push button may be utilized to control solenoid 122. The reversing switch may be operated periodically in a totally automatic manner by merely connecting suitable timing mechanisms or circuitry with solenoid 122 to control the operation thereof.

The stacked contact structures 16 and 18 are substantially identical in construction; and, advantageously, the contact blocks, connectors and conductive members are made of copper while the insulating layers are made of an electrically insulating plastic such as Bakelite or a laminated hardboard such as Benelex. As previously mentioned the arc suppressing contacts may be made of a silver-tungsten composition, and the conductor bar may be made of copper. The components of the arc suppressing assemblies and the control system are otherwise made of electrically insulating materials where feasible.

Since contact blocks 34 and 40 and member 44 are permanently electrically connected, it will be appreciated that they could be constructed as a single component and that they operate together as a single element or terminal. Similarly, contact blocks 58 and 64 and member 68 may be integrally constructed and operate together as a single element or terminal.

The component switch assemblies 136, 138, 140 and 142 may be utilized individually with a connector assembly to provide a transfer switch. That is, for example, the structure and configuration of the contacts and connector of a single switch, such as 136, may be advantageously utilized to make and break circuits due to the conical mating configuration of the bore and the connector. It is noted, however, that this structure is extremely advantageous for use in the reversing switch of the present invention in that movement of the piston rods is precisely limited by engagement of the connectors in the bores. That is, by arranging the stacked contact structures such that conical bores 48 and 72 and conical bores 50 and 74 are axially aligned and operating the connectors 76 and 80 as a unit and the connectors 78 and 82 as a unit, the conical mating configuration of the switches precisely limits movement to in-

crease timing accuracy while providing smooth even contact to increase current handling capability.

Of course, if arcing does not present a problem in the application of the reversing switch, such as where the power supply is disconnected prior to reversing the state of the switch, the arc suppressing assemblies may be omitted; and, if so desired, the reversing switch or a single component switch may be immersed in oil or other liquid preventing arcing and obviating the need for the arc suppressing assemblies.

The reversing switch may be utilized with any suitable power supply **144** where it is desirable to reverse the current or voltage therefrom through the load; and, of course, the supply may constitute either an original source or a source such as a rectified AC.

Since the present invention is subject to many variations, modifications and changes in detail, it is intended that all matter described above or shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. An electrical switch comprising

stacked contact structure including a first block of conductive material defining a first contact, a second block of conductive material defining a second contact and a layer of electrically insulating material disposed between said first and second blocks;

a conical bore in said contact structure centered with said layer of electrically insulating material, said conical bore having an axis lying in the plane of said layer of electrically insulating material;

a conical connector movable along the axis of said conical bore; and

control means for moving said connector into and out of said bore;

said bore and said connector having mating configurations whereby the outer surface of said connector continuously engages said first and second blocks when said connector is inserted in said bore.

2. The electrical switch as recited in claim **1** wherein said conical bore extends entirely through said contact structure.

3. An electrical switch comprising

stacked contact structure including a first block of conductive material defining a first contact, a second block of conductive material defining a second contact and a layer of electrically insulating material disposed between said first and second blocks;

a conical bore in said contact structure centered with said layer of electrically insulating material;

a conical connector movable along the axis of said conical bore;

control means for moving said connector into and out of said bore;

said bore and said connector having mating configurations whereby the outer surface of said connector continuously engages said first and second blocks when said connector is inserted in said bore; and

an arc suppressing assembly including a rod carrying said connector, a first arc suppressing contact carried by said second block and third and fourth arc suppressing contacts carried by said rod at a position to engage said first and second arc suppressing contacts when said conical connector is within arcing distance of the inner surface of said conical bore.

4. The electrical switch as recited in claim **3** and further comprising electrically conductive support means slidably mounted on said rod for supporting said third and fourth arc suppressing contacts, and spring means biasing said support means toward said position to engage said first and second arc suppressing contacts when said conical connector is within arcing distance of the inner surface of said conical bore.

5. The electrical switch as recited in claim **4** wherein the axis of said conical bore lies in the plane of said layer of insulating material.

6. An electrical switch for reversing the current supplied to a load from a DC source comprising

first contact means including a first terminal adapted to be connected with a terminal of the DC source, a first contact block and a second contact block, said first terminal, said first contact block and said second contact block being disposed in stacked relation with said first and second contact blocks disposed on opposite sides of an electrically insulated from said first terminal;

second contact means including a second terminal adapted to be connected with another terminal of the DC source, a third contact block, and a fourth contact block, said second terminal, said third contact block and said fourth contact block being disposed in stacked relation with said third and fourth contact blocks disposed on opposite sides of and electrically insulated from said second terminal;

first means connected with said first and third contact blocks and adapted to be connected with a terminal of the load;

second means connected with said second and fourth contact blocks and adapted to be connected with another terminal of the load; and

control means for connecting said first terminal with said first contact block and said second terminal with said fourth contact block for adapting said electrical switch to supply current to the load in a first direction and for connecting said first terminal with second contact block and said second terminal with said fourth contact block for adapting said electrical switch to supply current to the load in a second direction opposite to the first direction.

7. The electrical switch as recited in claim **6** wherein said first contact means includes a first layer of electrically insulating material separating said first terminal from said first contact block and a second layer of electrically insulating material separating said first terminal from said second contact block, and said second contact means includes a third layer of electrically insulating material separating said second terminal from said third contact block and a fourth layer of electrically insulating material separating said second terminal from said fourth contact block.

8. The electrical switch as recited in claim **7** wherein said first contact means includes a first conical bore extending into said first terminal and said first contact

block and centered at said first insulating layer and a second conical bore extending into said first terminal and said second contact block and centered at said second insulating layer, and said second contact means includes a third conical bore extending into said second terminal and said third contact block and centered at said third insulating layer and a fourth conical bore extending into said second terminal and said fourth contact block and centered at said fourth insulating layer.

9. The electrical switch as recited in claim 8 wherein said control means includes a first conical connector movable along the axis of said first bore and having a mating configuration with said first bore, a second conical connector movable along the axis of said second bore and having a mating configuration with said second bore, a third conical connector movable along the axis of said third bore and having a mating configuration with said third bore, and a fourth conical connector movable along the axis of said fourth bore and having a mating configuration with said fourth bore.

10. The electrical switch as recited in claim 9 wherein said first terminal, said first contact block and said first connector form a first switch assembly, said first terminal, said second contact block and said second connector form a second switch assembly, said second terminal, said third contact block and said third connector form a third switch assembly, said second terminal, said fourth contact block and said fourth connector form a fourth switch assembly, and each of said first, second, third and fourth switch assemblies includes an arc suppressing assembly including a rod carrying said connector, a first arc suppressing contact carried by said contact block, a second arc suppressing contact carried by said terminal and third and fourth arc suppressing contacts carried by said rod at a position to engage said first and second arc suppressing contacts when said connector is within arcing distance of the inner surface of said bore.

11. The electrical switch as recited in claim 10 wherein each of said arc suppressing assemblies includes electrically conductive support means slidably mounted on said rod for supporting said third and fourth arc suppressing contacts, and spring means biasing said support means toward said position to engage said first and second arc suppressing contacts when said connector is within arcing distance of the inner surface of said conical bore.

12. The electrical switch as recited in claim 11 wherein the axes of said first, second, third and fourth conical bores lie in the planes of said first, second, third and fourth insulating layers, respectively.

13. The electrical switch as recited in claim 12 wherein said control means includes a first pneumatic cylinder having first rod means carrying said first and third connectors, a second pneumatic cylinder having second rod means carrying said second and fourth connectors and a pneumatic control device communicating with said first and second pneumatic cylinders for moving said first and second rod means in opposite directions simultaneously.

14. The electrical switch as recited in claim 9 wherein said control means includes first means supporting said first and third connectors, second means supporting said second and fourth connectors, and a control device for moving said first and second means in opposite directions simultaneously.

15. The electrical switch as recited in claim 14 wherein said first and third connectors are movable along a common axis and said second and fourth connectors are movable along a common axis.

16. The electrical switch as recited in claim 9 wherein said first and second bores have a common axis and said second and fourth bores have a common axis.

17. The electrical switch as recited in claim 6 wherein said control means includes a first connector movable to connect said first terminal and said first contact block, a second connector movable to connect said first terminal and said second contact block, a third connector movable to connect said second terminal and said third contact block and a fourth connector movable to connect said second terminal and said fourth contact block, and further comprising arc suppressing means movable with each of said first, second, third and fourth connectors to connect respective ones of said terminals with respective ones of said contact blocks when said respective connectors within arcing distance of said respective terminals and contact blocks.

18. The electrical switch as recited in claim 6 wherein said control means includes a first connector movable to connect said first terminal and said first contact block, a second connector movable to connect said first terminal and said second contact block, a third connector movable to connect said second terminal and said third contact block, a fourth connector movable to connect said second terminal and said fourth contact block, and said control means includes first means supporting said first and third connectors, second means supporting said second and fourth connectors, and a control device for moving said first and second means in opposite directions simultaneously.

19. The electrical switch as recited in claim 6 wherein said control means includes first connector means movable to connect said first terminal and said first contact block and to connect said second terminal and said third contact block, second connector means movable to connect said first terminal and said second contact block and to connect said second terminal and said fourth contact block, and further comprising arc suppressing means movable with each of said first and second connector means to connect respective ones of said terminals with respective ones of said contact blocks when said respective connector means are within arcing distance of said respective terminals and contact blocks.

* * * * *