

[54] **COMBINED SUSPENSION DEVICE FOR HOLDING, CONTACTING, SLIPPING AND TORQUING ELECTRIC FURNACE ELECTRODES**

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[51] Int. Cl.² **H05B 7/10; H05B 7/14**

[58] Field of Search **13/14-18**

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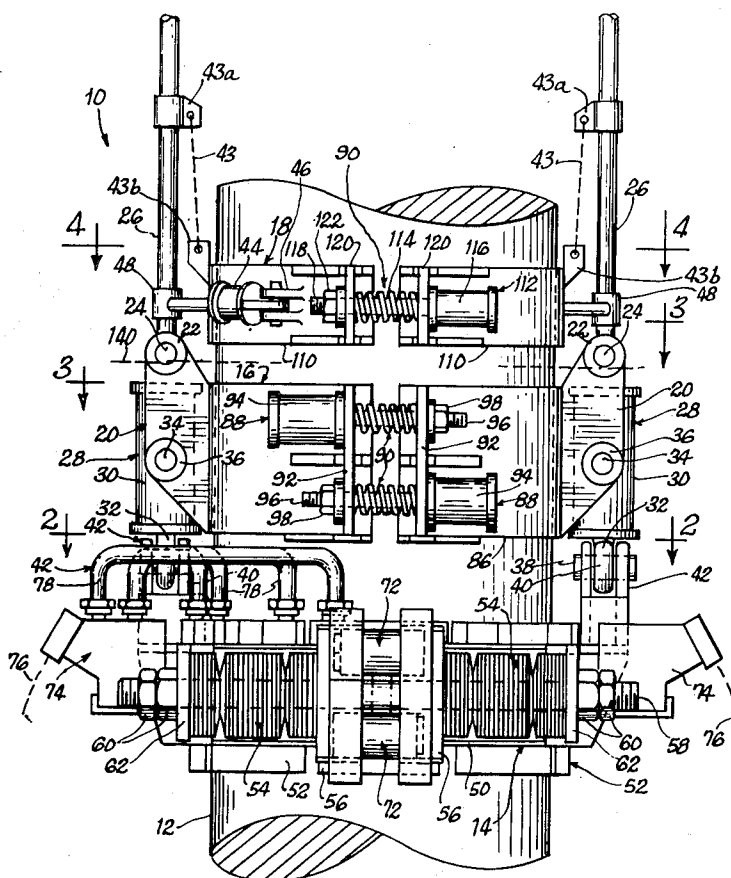
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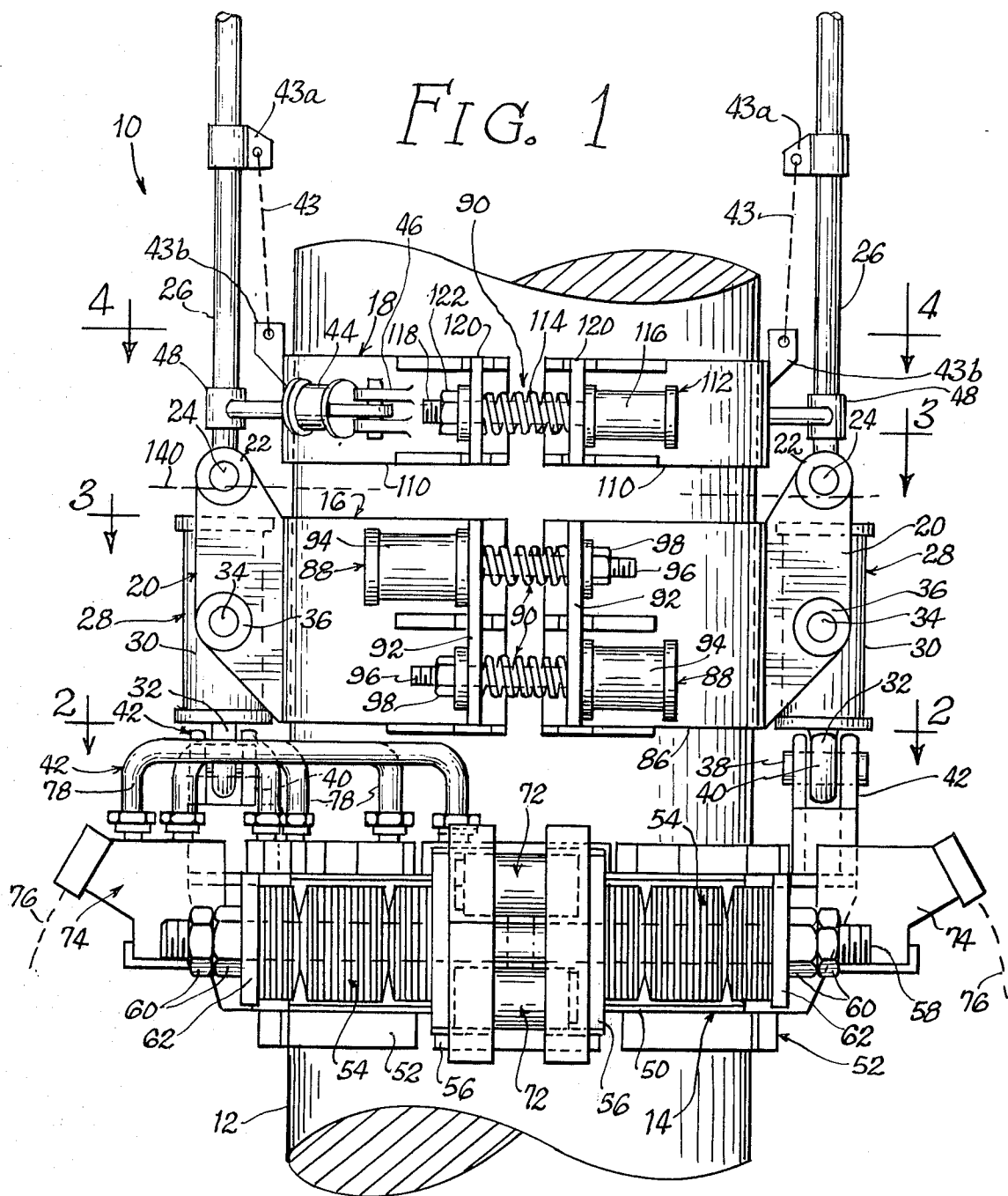
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ABSTRACT

The disclosed device comprises a generally circular slipping clamp for receiving the electrode, fluid power means for tightening the slipping clamp, spring means for loosening the slipping clamp, a plurality of suspension elements for suspending the slipping clamp and thereby supporting the weight of the electrode, a generally circular contact clamp disposed below the slipping clamp for receiving the electrode, spring means for tightening the contact clamp, fluid power means for loosening the contact clamp, a plurality of fluid power force exerting devices connected between the contact clamp and the slipping clamp for suspending the contact clamp and for producing relative movement between the contact clamp and the slipping clamp, a torquing clamp disposed above and supported by the slipping clamp, fluid power means for tightening the torquing clamp, spring means for loosening the torquing clamp, and fluid power force exerting means connected between the torquing clamp and the suspension elements for the slipping clamp for producing relative turning movement therebetween whereby screw joints between electrode sections can be tightened.

15 Claims, 4 Drawing Figures





SHEET 2

FIG. 2

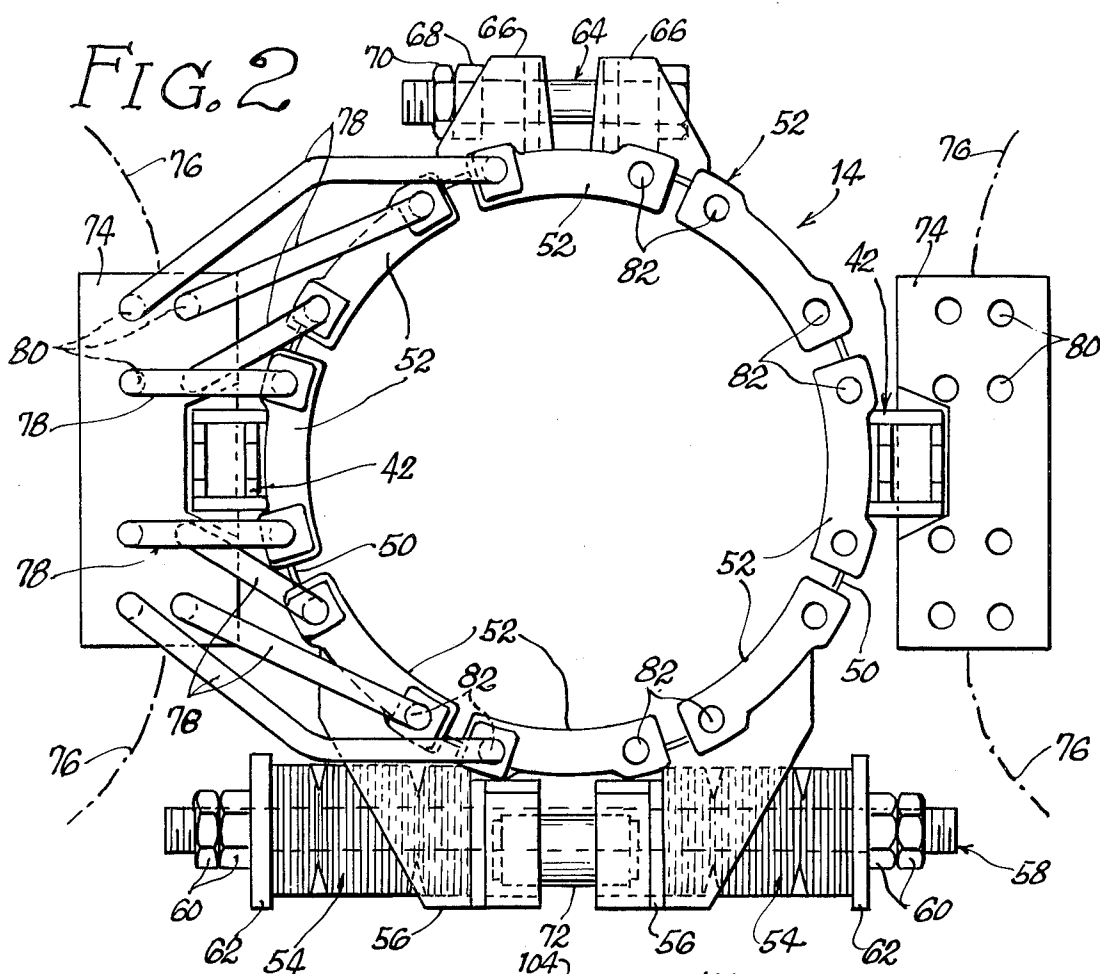


FIG. 3

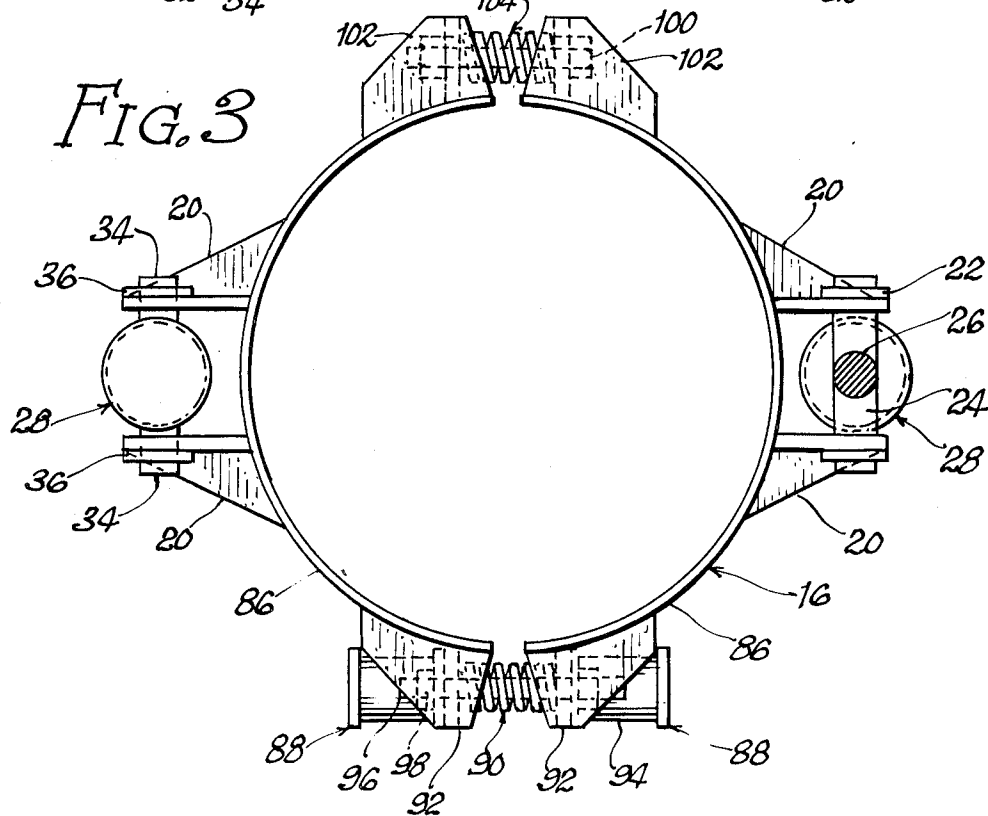
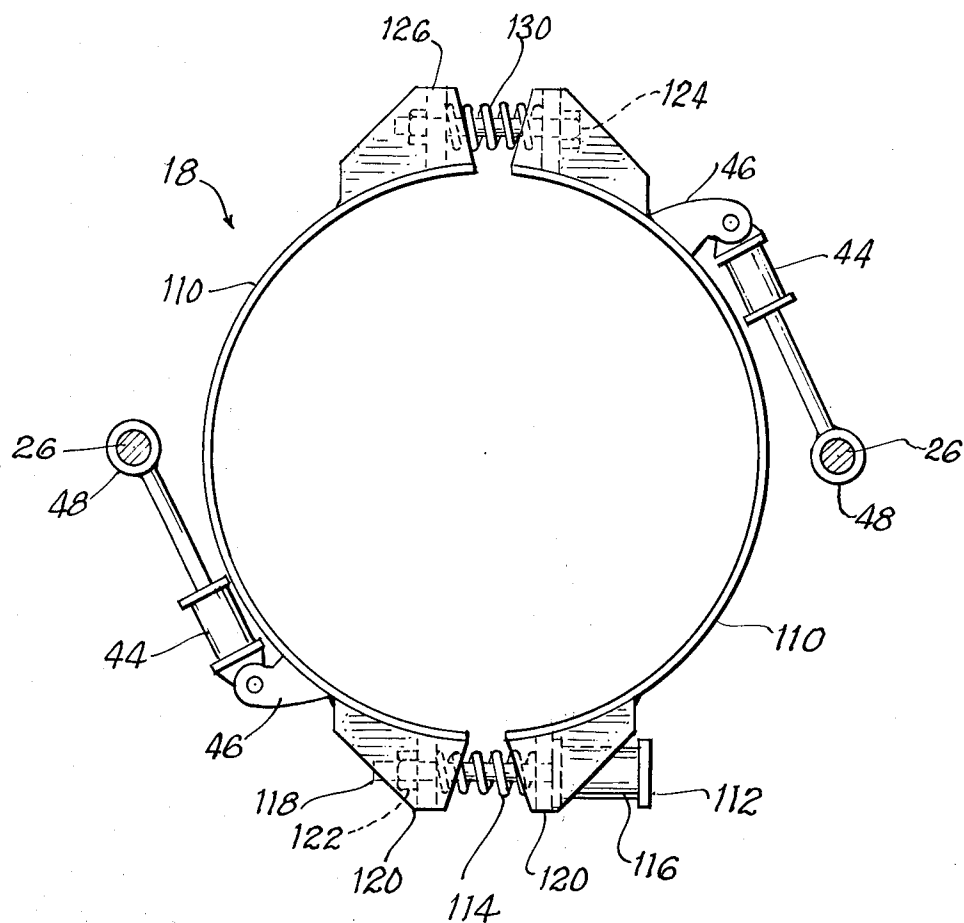


FIG. 4



COMBINED SUSPENSION DEVICE FOR HOLDING, CONTACTING, SLIPPING AND TORQUING ELECTRIC FURNACE ELECTRODES

This invention relates to a combined suspension device for holding, contacting, slipping and torquing cylindrical electrodes of the types used in connection with electric furnaces. The suspension device is especially advantageous for suspending electrodes on electric furnaces which require the electrodes to be continuously fed into the furnace as they are consumed.

Electro-thermal processes are carried out by the operation of electric furnaces in which electrical energy is utilized as the necessary source of heat for the smelting and reduction of ores, or the melting of metals. A typical electric furnace unit comprises a crucible constructed with a steel shell having a refractory lining. Tap holes are provided for the removal of molten products from the crucible. The electric furnace crucible may have an open top, or a refractory roof to provide an airtight cover, particularly when it is desired to recover the gases evolved in the smelting process.

In both covered and uncovered crucibles, one or more electrodes are provided in the furnace and are generally suspended vertically. A prepared burden of ore or metal is charged into the furnace around the electrodes. Electric current is supplied to the electrodes from a transformer through highly conductive metal bus conductors. Usually, there are three electrodes, connected to the transformer by three bus conductors, in a three phase delta arrangement. The electrodes conduct the electrical current into the smelting zone of the furnace.

As the electrical current is supplied, heat is generated at the lower tip of each electrode, and the smelting process begins. Since it is desirable, for a number of reasons, to maintain a constant electrical load on the furnace, it is advantageous to operate the furnace with only one variable. Usually, a constant voltage is maintained and the amperage varies as the resistance in the furnace changes. As the smelting process progresses, the heated charge in the furnace offers less resistance to the passage of the electric current. To prevent the current from becoming excessive, it is desirable to raise the electrodes to produce a longer path for the current to travel, whereby the resistance of the path is increased correspondingly.

On the other hand, when a cooler incoming furnace charge is fed into the smelting zone, the electrical resistance increases, and it is necessary to lower the electrodes accordingly, to prevent the electrical current from decreasing to an undesirable extent. This mode of operation means that the electrodes are frequently moving up and down, to hunt for a balance point. The up and down movement of the electrodes is usually produced by hoisting winches or hydraulic cylinders, which are incorporated into the suspension system for the electrodes. Controls are provided to regulate the amount of movement produced by the winches or the hydraulic cylinders, so that a balance in the electrical currents can be achieved.

Two types of electrodes are commonly used, prebaked carbon electrodes which include semigraphite and graphite; and electrodes utilizing a pitch blend or initially unbaked carbon mixture, encased in sheet metal tubes, commonly known as Soderburg electrodes.

The major problems associated with the operation of electric furnaces are related to the electrodes. As the capacity and size of electric furnaces are increased, the electrode system becomes more complex from a physical standpoint. As each electrode is consumed in the furnace, the practice has been to add on a new section to the upper end of the electrode column. The new section is joined onto a prebaked carbon electrode by screwing the new section onto a threaded carbon or graphite connecting nipple. The joint is tightened by a torquing device. In the case of a Soderburg electrode, a new section is added by welding on a new section of metal casing, which is then filled with a pitch carbon mixture.

After the new section has been added, the electrode is slipped the required amount through the electrical clamp to accommodate the normal electrode travel for electrical balance in the furnace. For several reasons, it is desirable to slip the electrode through the electrical clamp without shutting off the input electrical power to the furnace.

The electrical clamp, the holding clamp, the slipping device and the torquing device are remotely separated or spread apart in the electrode suspension systems of existing furnaces. Present suspension systems often require an electrode column up to sixty feet or even more in length, to accommodate the required equipment, which is so massive and complex that such equipment cannot be located in the limited space immediately above the furnace. In the existing systems, the electrode column is supported by a holding clamp which is rigidly located at the upper end of the electrode column and is designed primarily for use with Soderburg electrodes, which are non-rigid above the heat zone of the furnace.

Electrodes are subject to varying side pressures or stresses, as the furnace burden moves downward within the furnace. These side forces cause deviation in the vertical attitude of the electrodes. Since prebaked carbon electrodes have no flexibility, these electrodes have sometimes caused intolerable problems in existing systems. Excessive electrode breakage has occurred due to the rigid alignment and clamping of the electrode at its upper end, whereby the connecting nipples are subjected to excessive stresses, exerted by the weight of the long electrode column.

Other methods in use for clamping, slipping and torquing electrodes require a centerline support, actuated from an overhead crane, or other auxiliary devices, and are operated manually. The present systems are complicated and are prone to cause delays and down time on the furnace. Moreover, present systems often present safety hazards to operating personnel. These factors add greatly to production costs.

One object of the present invention is to provide a new and improved electrode suspension device which incorporates new operating principles and mechanical features so as to eliminate the faults which have plagued the operation of existing equipment, now in use.

The device of the present invention is unique in that it combines all four functions, electrical contact, support clamping, slipping and torquing, into one unit which is compact enough to be installed so as to operate immediately above the furnace. Operating in this position reduces the length of the electrode column by

40 to 50 percent of the length required by existing devices, adapted to be used in the same service.

The device of the present invention provides flexibility to accommodate any deviation of the vertical attitude of the electrodes that might occur.

The device of this invention operates automatically without furnace delays or down time for slipping electrodes.

Moreover, the device of the present invention is simple and sturdy in design, requiring a minimum of maintenance.

The device of this invention is relatively light in weight, so as to reduce the total weight to be handled by the hoisting equipment, thus making it possible to bring about an overall reduction in the size of the auxiliary hoisting equipment and the investment costs in supporting structures.

In addition, the device of the present invention is suitable for use with either prebaked carbon or Soderburg electrodes.

Furthermore, the device of this invention eliminates safety hazards to operating personnel which occur in existing practice.

Further objects, advantages and features of the present invention will appear from the following description, taken with the accompanying drawings, in which:

FIG. 1 is an elevational view showing a combined suspension device, to be described as an illustrative embodiment of the present invention.

FIG. 2 is a horizontal sectional view, taken generally along the line 2—2 in FIG. 1.

FIGS. 3 and 4 are additional horizontal sectional views, taken generally along the lines 3—3 and 4—4, respectively, in FIG. 1.

As just indicated, FIG. 1 illustrates a combined suspension device 10 for holding, contacting, slipping and torquing a cylindrical electric furnace electrode 12, which may be of any known or suitable type, such as the prebaked rigid carbon type, or the Soderburg type. The illustrated suspension device comprises three generally circular clamps, for receiving the cylindrical electrode 12, including a contact clamp 14, a slipping clamp 16 and a torquing clamp 18.

In this case, the slipping clamp 16 is adapted to be suspended from any suitable lifting device. Thus, the slipping clamp 16 is provided with suspension means, including a plurality of outwardly projecting clevis brackets 20 which are fitted with bearings 22 adapted to receive horizontal pivots 24. The lower ends of tension members 26 are secured to the pivots 24. Such tension members 26 may take the form of cables, rods, or the like, extending upwardly to an overhead lifting device. The pivots 24 and the tension members 26 provide flexibility, so that the electrode 12 can deviate appreciably from its normal vertical position, without producing excessive stresses in the electrode 12 and the suspension device 10.

As shown in FIG. 1, the contact clamp 14 is disposed below the slipping clamp 16. Means are provided to suspend or otherwise support the contact clamp 14 from the slipping clamp 16. Such means also make it possible to produce relative vertical movement between the contact clamp 14 and the slipping clamp 16. In this case, such means comprise a plurality of fluid power devices 28, connected between the contact clamp 14 and the slipping clamp 16, and capable of exerting force therebetween to produce relative vertical

movement. The fluid power devices 28 may take the form of hydraulic cylinders, each of which comprises a body or casing 30 and a piston rod 32 which is movable outwardly and inwardly, relative to the body 30. As shown, the body 30 of each hydraulic cylinder 28 is pivotally connected to the slipping clamp 16, while the piston rod 32 is pivotally connected to the contact clamp 14, but this situation could be reversed. In the construction shown in FIG. 1, horizontal pivots 34 are provided on the bodies 30 of the hydraulic cylinders 28 and are supported by bearings 36 on the brackets 20.

The piston rod 32 on each hydraulic cylinder 28 is pivotally connected to the contact clamp 14. Thus, a pivot pin 38 is provided to extend through an apertured member 40 on the lower end of each piston rod 32. In each case, the pivot 38 also extends through a clevis 42 on the contact clamp 14. The pivot arrangement utilizing the pivot 38, the apertured member 40 and the clevis 42 provides flexibility, so that appreciable angular deviation of the electrode 12 can be accommodated without producing any excessive stresses in the electrode 12.

The illustrated torquing clamp 18 is disposed around the electrode 12 above the slipping clamp 16. Means are provided whereby the torquing clamp 18 derives its support from detention elements 26 which support the slipping clamp 16. In this case, the tension elements 26 are in the form of rods. Flexible tension members 43, such as cables or chains, are connected between brackets 43a, secured to the rods 26, and brackets or lugs 43b, secured to the torquing clamp 18.

The torquing clamp 18 is provided with power operated force exerting means for producing relative turning movement between the torquing clamp 18 and the slipping clamp 16. As shown in FIGS. 1 and 4, such power operated means may take the form of a plurality of hydraulic cylinders 44, acting in a peripheral direction between the torquing clamp 18 and the suspension rods 26 which support the slipping clamp 16. As shown, each hydraulic cylinder 44 is connected between a member 46, secured to the torquing clamp 18, and a member 48, slidably mounted around the corresponding rod 26. The hydraulic cylinders 44 are attached to exert forces which produce relative torque between the torquing clamp 18 and the suspension rods 26, which transmit such torque to the slipping clamp 16.

This torque may be employed to tighten screw joints between electrode sections. Such tightening becomes necessary when a new electrode section is added to the upper end of an old section, previously put into use. The tightening or torquing operation is carried out by using the torquing clamp 18 to grip the new electrode section, while using the slipping clamp 16 to hold the old section. The torquing hydraulic cylinders are then employed to produce relative turning movement between the new and old sections, until the screw joint therebetween is tightened.

Additional details of the contact clamp 14 are shown in FIGS. 1 and 2. It will be seen that the contact clamp 14 comprises a pair of generally semi-circular bands 50 on which a plurality of contact shoes or pads 52 are mounted. The contact shoes or pads 52 are adapted to conduct electrical currents to the electrode 12. Thus, the contact shoes or pads 52 are preferably made of copper or some other material which has a high electrical conductivity.

The clamping bands 50 are adapted to be tightened by springs 54, acting against brackets or lugs 56 which are secured to the adjacent ends of the bands 50, as shown in FIG. 2. Springs of any suitable type may be employed. As shown, the springs 54 are in the form of a multiplicity of compressible saucer-shaped spring discs which are apertured so that they can be mounted on a threaded rod 58. Nuts 60 and end plates 62 are mounted on the opposite ends of the rod 58, for regulating the extent to which the springs 54 are compressed initially. The rod 58 extends between the brackets 56 which are apertured to receive the rod.

To make additional provision for adjustment of the semi-circular clamping bands 50, an adjusting bolt 64 is connected between lugs or brackets 66 which are secured to the opposite ends of the clamping bands 50. The brackets 66 are apertured to receive the bolt 64, which is fitted with an adjusting nut 68 and a lock nut 70 so that the effective length of the bolt can be adjusted. In this way, the effective size of the clamping band 50 can be varied.

The contact clamp 14 is provided with operating means for loosening and tightening the clamp. As shown in FIGS. 1 and 2, such operating means may comprise fluid power means in the form of one or more hydraulic cylinders 72 extending between the brackets or lugs 56. In this case, two of the hydraulic cylinders 72 are provided to overcome the force exerted by the springs 54, so that the clamping band 50 can be loosened. The hydraulic cylinders 72 are adapted to move the lugs or brackets 56 away from each other. Only a slight movement is needed to release the contact clamp 14. The hydraulic cylinders 72 may be remotely controlled by a hydraulic control valve, or any other known or suitable control means, as will be understood by those skilled in the art.

The contact clamp 14, as illustrated in FIGS. 1 and 2, is provided with one or more electrical terminal blocks 74, to which electrical currents may be supplied by means of cables 76 or other conductors, connected to the power transformer, or any other suitable power supply. The terminal blocks 74 are preferably made of copper or some other material having high electrical conductivity. Electrical conductors 78 are connected between the terminal blocks 74 and the contact shoes or pads 52. In this case, the conductors 78 take the form of tubes made of copper or some other highly conductive material. In addition to supplying electrical currents to the contact shoes or pads 52, the conductor tubes 78 may be employed to provide for the circulation of cooling water, or some other cooling medium, through the contact shoes 52. The cooling medium also cools the terminal blocks 74. Thus, the contact shoes 52 and the terminal blocks 74 are preferably hollow to afford passages for the circulation of cooling water. The conductor tubes 78 are connected between ports 80 in the terminal blocks 74 and ports 82 in the contact shoes 52. The ports 80 and 82 are employed for the circulation of cooling water. It will be seen that each contact shoe 50 is provided with two of the ports 82 to form inlet and outlet openings for the cooling water. The left-hand portion of FIG. 2 shows a full set of the conductor tubes 78, but the tubes have been omitted in the right-hand portion of FIG. 2, so that the ports 80 and 82 may be clearly shown. It will be understood that all of the contact shoes 52 are supplied with both electrical currents and cooling water.

Additional details of the slipping clamp 16 are shown in FIGS. 1 and 3. It will be seen that the clipping clamp 16 comprises a pair of generally semi-circular clamping bands 86 which can be tightened and loosened around the electrode 12. Operating means are provided to tighten and loosen the clamping bands 86. In this case, the bands 86 are adapted to be tightened by power means 88, and to be loosened by spring means 90. The illustrated power means 88 may take the form of hydraulic cylinders, or any other suitable fluid power means. Two of the hydraulic cylinders 88 are employed in this case, as shown in FIG. 1, and are connected between brackets or lugs 92 which are secured to the ends of the clamping bands 86.

Each hydraulic cylinder 88 may comprise a body or casing 94 and a piston rod 96. The casing 94 is mounted against one of the brackets 92, while the piston rod 96 extends between the brackets 92, which are apertured to receive the piston rod 96. An adjusting nut 98 is preferably threaded onto the end of each piston rod 96.

The spring means 90 preferably take the form of compression coil springs, mounted around the piston rods 96, and compressed between the brackets 92.

When the hydraulic cylinders 88 are actuated so as to draw in the piston rods 96, the clamping bands 86 are tightened against the resilient resistance of the springs 90. When fluid pressure is released from the hydraulic cylinders 88, the springs 90 are effective to loosen the clamping bands 86.

As before, additional adjustment of the clamping bands 86 is provided by an adjusting bolt 100 which is connected between lugs or brackets 102 at the opposite ends of the clamping bands 86. A compression spring 104 is preferably mounted around the bolt 100, between the brackets 102, to bias the brackets away from each other when the bolt 100 is loosened. By adjusting the bolt 100, the initial size of the slipping clamp 16 can be adjusted.

As previously indicated, the clevis brackets 20 are mounted on the generally semi-circular clamping bands 86.

Additional details of the torquing clamp 18 are shown in FIGS. 1 and 4. It will be seen that the torquing clamp 18 comprises a pair of generally semi-circular clamping bands 110, adapted to be tightened and loosened around the electrode 12 by operating means. In this case, such operating means include power means 112 for tightening the bands 110, and spring means 114 for loosening the bands. The illustrated power means 112 take the form of a hydraulic cylinder having a casing 116 and a piston rod 118, extending between brackets 120 secured to the ends of the clamping bands 110. The casing 116 is mounted against one of the brackets 120, which are apertured to receive the piston rod 118. An adjusting nut 122 is preferably threaded onto the end of the piston rod 118 for use in regulating the size of the torquing clamp 18.

The illustrated spring means 114 take the form of a compression coil spring, mounted around the piston rod 118, and disposed between the brackets 120. When the hydraulic cylinder 112 is actuated so as to draw in the piston rod 118, the clamping bands 110 are tightened against the resilient resistance afforded by the spring 114. When fluid pressure is released from the hydraulic cylinder 112, the clamping bands 110 are loosened by the force of the spring 114.

To afford additional adjustment for the clamping bands 110, an adjusting bolt 124 is connected between lugs or brackets 126 on the opposite ends of the bands 110. An adjusting nut 128 is threaded onto the bolt 124. Preferably, a compression coil spring 130 is mounted around the bolt 124 and is disposed between the brackets 126, to bias the brackets away from each other when the bolt 124 is loosened.

During the operation of the suspension device 10, the electrode holding function is ordinarily performed by the electrical contact clamp 14, which supports the weight of an electrode 12. The contact clamp 12 is normally in its lowermost position, with the piston rods 32 of the hydraulic cylinders 28 fully extended, rather than being fully retracted, as shown in FIG. 1. The clamping pressure to tighten the contact clamp 12 is developed by the springs 54. Thus, the full weight of the electrode 12 is supported without the use of hydraulic pressure. This arrangement eliminates the necessity of maintaining hydraulic pressure to support the electrode 12.

During normal operation of the electric furnace, the lower end of the electrode 12 is gradually consumed, so that it becomes necessary, from time to time, to extend new portions of the electrode into the furnace. This is done by slipping the electrode through the electrical contact clamp 14.

To accomplish the slipping operation, the slipping clamp 16 is tightened fully so that it is capable of supporting the weight of the electrode 12. The slipping clamp 16 is tightened by supplying hydraulic pressure to the hydraulic cylinders 88 so as to draw in the piston rods 96.

The electrical contact clamp 14 is then loosened sufficiently to permit the contact clamp 14 to be slipped along the electrode 12. The contact clamp 14 is loosened by supplying hydraulic pressure to the hydraulic cylinders 72, which counteract the force of the springs 54 so as to relieve the clamping pressure. To slip the contact clamp 14 along the electrode 12, hydraulic pressure is applied to the hydraulic cylinders 28 so as to draw in the piston rods 32. The actuation of the hydraulic cylinders 28 raises the electrical contact clamp 14 by an amount corresponding to the full stroke of the hydraulic cylinders 28.

While maintaining the hydraulic pressure in the cylinders 28, the contact clamp 14 is tightened by releasing the hydraulic pressure in the hydraulic cylinders 72. The force exerted by the springs 54 then tightens the contact clamp 14 so that it will support the weight of the electrode 12.

The slipping clamp 16 is then loosened by releasing the hydraulic pressure in the hydraulic cylinders 88, whereupon the springs 90 are effective to loosen the clamp.

The electrode 12 can then be lowered into the furnace by slowly releasing the hydraulic pressure in the hydraulic cylinders 28, so as to lower the electrical contact clamp 14. Generally, the piston rods 32 are allowed to move downwardly to their fully extended positions, so that the contact clamp 14 and the electrode 12 are lowered by an amount corresponding to the full stroke of the hydraulic cylinders 28. As this lowering movement takes place, the electrode 12 slips through the slipping clamp 16 and the torquing clamp, which is also loosened during the slipping operation.

As the electrode is consumed, it is lowered into the furnace by a series of slipping operations; as just described, until the upper end of the electrode passes through the torquing clamp 13, to the approximate elevation indicated by a broken line 140 in FIG. 1. This broken line 140 is between the torquing clamp 18 and the slipping clamp 16.

A new electrode section is then joined to the upper end of the column. The lower end of the new electrode section is inserted through the torquing clamp 18 and is screwed onto the threaded nipple or coupler which is employed between the new section and the upper end of the old section.

The torquing clamp 18 and the torquing hydraulic cylinders 44 are then employed to tighten the new electrode section, so that the threaded joint will be tight and secure.

To carry out the torquing operation, the torquing clamp 18 is tightened around the new electrode section by supplying hydraulic pressure to the hydraulic cylinder 112. The slipping clamp 16 is tightened by supplying hydraulic pressure to the hydraulic cylinders 88. Torque is then developed between the torquing clamp 18 and the slipping clamp 16 by supplying hydraulic pressure to the torquing cylinders 44. The peripheral forces developed by the hydraulic cylinders 44 cause relative turning movement between the new electrode section, held by the torquing clamp 18, and the old electrode section, held by the slipping clamp 16.

If necessary, the torquing operation can be repeated by loosening the torquing clamp 18, reversing the torquing cylinders 44 so as to turn back the torquing clamp 18, relative to the new electrode section, tightening the torquing clamp 18, and again actuating the torquing cylinders 44 so as to turn the new electrode section relative to the old electrode section.

After the joint between the new electrode section and the old electrode section has been tightened to the desired extent, both the slipping clamp 16 and the torquing clamp 18 may be loosened. The torquing cylinders 44 may then be reversed so as to rotate the torquing clamp 18 back to its normal resting position. Hydraulic pressure is then released from the torquing cylinders 44.

The electrode contact clamp 14 is effective to support the full weight of the electrode 12 without the use of hydraulic pressure, because the clamping force for tightening the contact clamp 14 is provided by the springs 54. Thus, the suspension device supports the electrode 12 in a safe manner, even if there is a total failure of the hydraulic system.

If desired, however, the slipping clamp 16 and the torquing clamp 18 may be kept tightened during normal operation, by supplying hydraulic pressure to the hydraulic cylinders 88 and 112, except when the slipping operation is being carried out. The tightening of the slipping clamp 16 and the torquing clamp 18, or either of them, will provide an added factor of safety in preventing any unexpected downward movement of the electrode 12.

It will be understood that the entire suspension device 12 is very compact, so that it may be located immediately above the electric furnace. The extent to which the electrode column needs to project above the furnace is minimized, so that the total weight of the electrode column is kept to a minimum.

The electrode column is supported in a flexible manner, so that it is very unlikely that lateral forces applied to the lower end of the electrode will cause breakage or damage to the electrode. The suspension device is well suited for use with both prebaked carbon electrodes and Soderburg electrodes.

The suspension device is uncomplicated in construction, so that very little maintenance will be required. Any necessary maintenance is easily carried out.

The suspension device is light in weight, so as to minimize the total weight which must be handled by the lifting device for the electrode.

I claim:

1. A combined suspension device for holding, contacting, slipping and torquing cylindrical electric furnace electrodes, comprising a generally circular slipping clamp for receiving a cylindrical electric furnace electrode, said slipping clamp having a plurality of suspension elements thereon for suspending said slipping clamp and the electrode, said slipping clamp having slipping clamp operating means for clamping and releasing said slipping clamp around the electrode, a generally circular electrode contact clamp for receiving the electrode, said electrode contact clamp being disposed below said slipping clamp, said electrode contact clamp having electrode contact clamp operating means for clamping and releasing said electrode contact clamp around said electrode, power operated force exerting means connected between said slipping clamp and said electrode contact clamp for supporting said electrode contact clamp and for exerting force between said slipping clamp and said electrode contact clamp, a generally circular torquing clamp disposed and supported above said slipping clamp for receiving the electrode, said torquing clamp having torquing clamp operating means for clamping and releasing said torquing clamp around the electrode, and power operated torquing means connected between said torquing clamp and said slipping clamp for exerting torque between said torquing clamp and said slipping clamp so as to produce relative turning movement therebetween about the cylindrical axis of the electrode.
2. A device according to claim 1, in which said suspension elements comprise clevis elements pivotally connected to said slipping clamp, and tension members extending upwardly from said clevis elements.
3. A device according to claim 1, in which said slipping clamp operating means comprise fluid power force exerting means.
4. A device according to claim 1, in which said contact clamp includes contact means for conducting electrical currents to the electrode.
5. A device according to claim 1, in which said contact clamp operating means comprise fluid power force exerting means.
6. A device according to claim 1, in which said power operated force exerting means include fluid power force exerting means.
7. A device according to claim 1,

in which said power operated force exerting means comprise a plurality of fluid power cylinders connected between said slipping clamp and said contact clamp for producing relative movement therebetween along the longitudinal dimension of the electrode and for suspending said contact clamp from said slipping clamp.

8. A device according to claim 1, in which said torquing clamp operating means comprise fluid power force exerting means.

9. A device according to claim 1, in which said torquing means include fluid power force exerting means.

10. A device according to claim 1, in which said power operated torquing means comprise a plurality of fluid power cylinders connected between said torquing clamp and said slipping clamp for producing relative turning movement between said torquing clamp and said slipping clamp.

11. A device according to claim 1, in which said slipping clamp operating means comprise fluid power force exerting means for tightening said slipping clamp and spring means for loosening said slipping clamp,

said contact clamp operating means including spring means for tightening said contact clamp and fluid power force exerting means for loosening said contact clamp,

whereby said contact clamp will support the electrode in the absence of fluid pressure.

12. A device according to claim 1, in which said slipping clamp operating means include fluid power force exerting means,

said contact clamp operating means including fluid power force exerting means,

said torquing clamp operating means including fluid power force exerting means,

said power operated force exerting means including fluid power force exerting means connected between said slipping clamp and said contact clamp, said power operated torquing means including fluid power force exerting means.

13. A device according to claim 1, in which said slipping clamp operating means include fluid power cylinder means for tightening said slipping clamp and spring means for loosening said slipping clamp,

said contact clamp operating means including spring means for tightening said contact clamp and fluid power cylinder means for loosening said slipping clamp,

said power operated force exerting means including a plurality of fluid power cylinders connected between said slipping clamp and said contact clamp for suspending said contact clamp and for producing relative movement between said contact clamp and said slipping clamp.

14. A device according to claim 13, in which said torquing clamp operating means include fluid power cylinder means for tightening said torquing clamp and spring means for loosening said torquing clamp.

15. A device according to claim 14, in which said power operated torquing means include fluid power cylinder means connected between said torquing clamp and said slipping clamp for producing relative turning movement therebetween.

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