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[33] **France**
[31] **6910161**

[54] ANODE ROD TIGHTENING APPARATUS FOR ALUMINA ELECTROLYSIS CELLS

8 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** ..... **204/297 R,** 204/225, 204/243 R, 204/286
[51] **Int. Cl.** **C23b 5/70,** C22d 3/02
[50] **Field of Search** 204/297, 286, 243–247, 225

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Assistant Examiner—D. R. Valentine
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ABSTRACT: An anode rod tightening apparatus for alumina electrolysis cells having main bus bars comprising the combination of a clamping device and a driving mechanism in which the clamping device is formed of a horizontally disposed shaft with a pair of levers articulated on the shaft and a nut member on each of the levers adapted to engage opposite screw-threaded sections on a screw member for displacement of the levers in the direction toward and away from each other responsive to turning movement of the screw and a jaw member on each lever adapted to engage the anode rod when the levers are apart and in which the driving mechanism comprises a double clamp for engaging laterally spaced apart portions of the shaft and a wrench mounted for vertical movement into and out of engagement with the screw to effect turning movement of the screw when in operative engagement therewith and a guide means along the rod for guiding the driving mechanism.

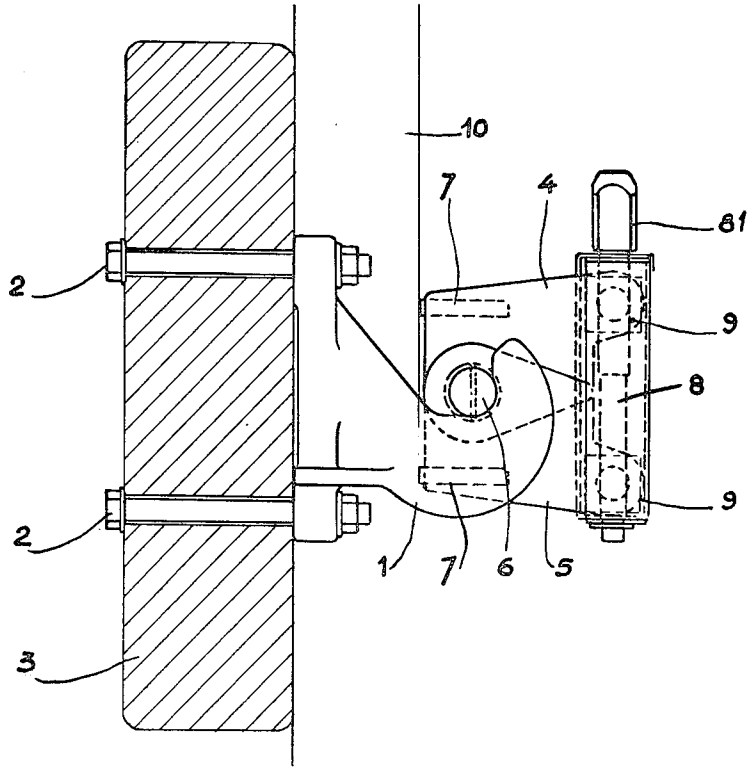

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FIG. 1

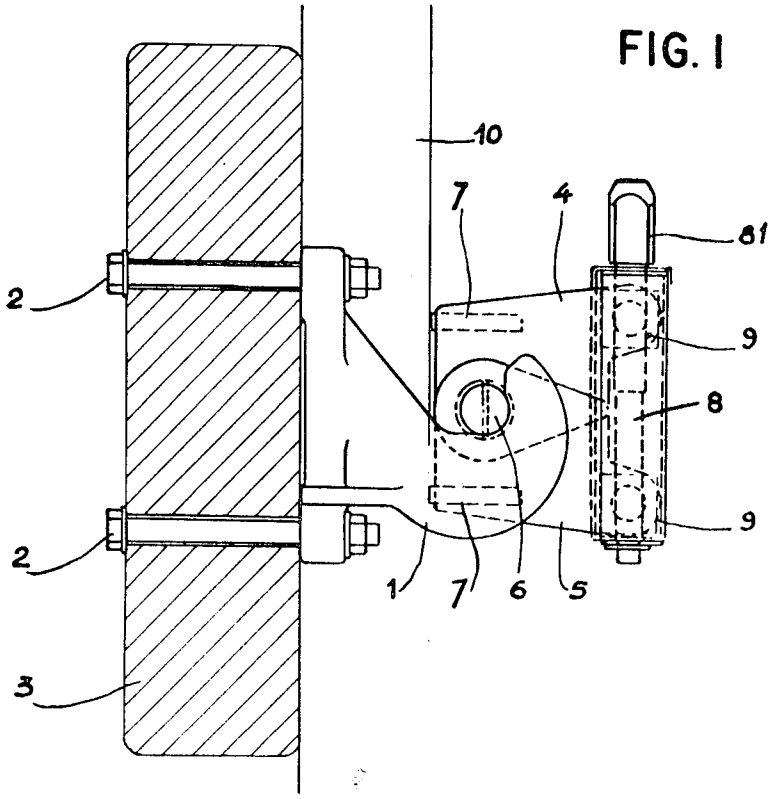
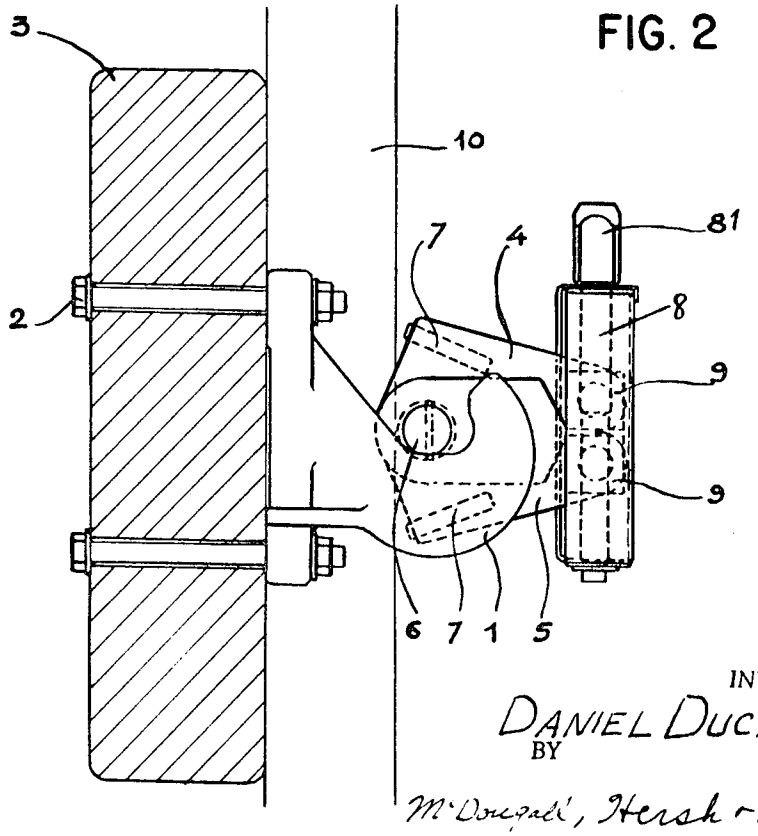


FIG. 2



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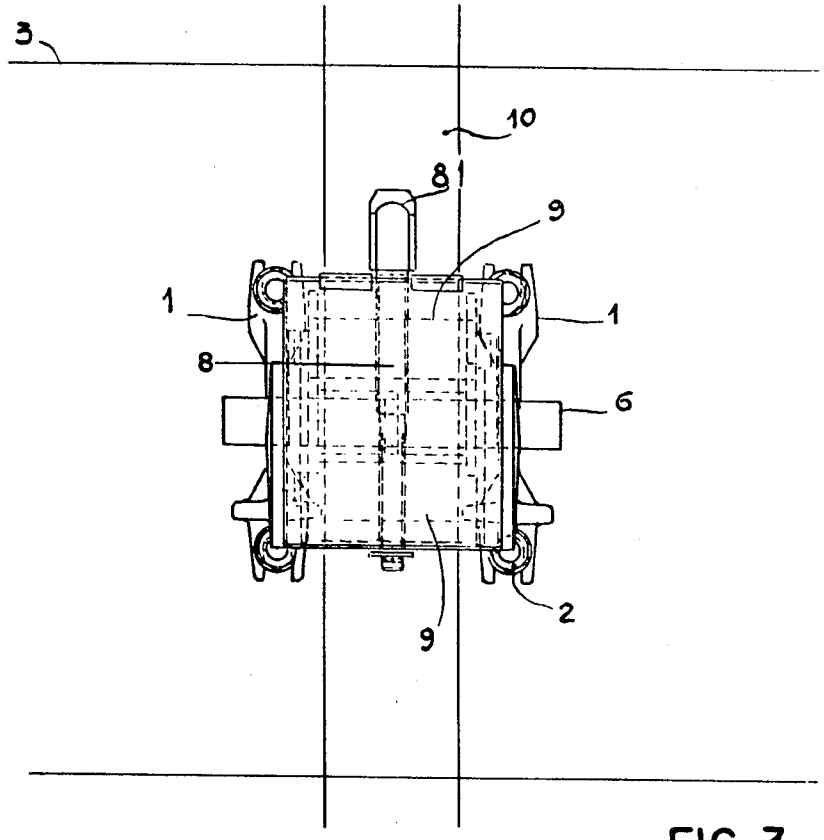


FIG. 3

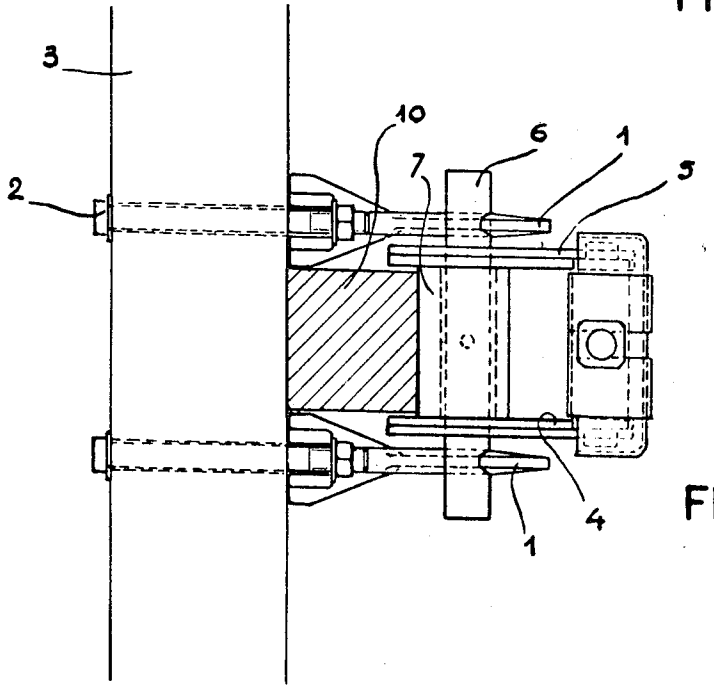


FIG. 4

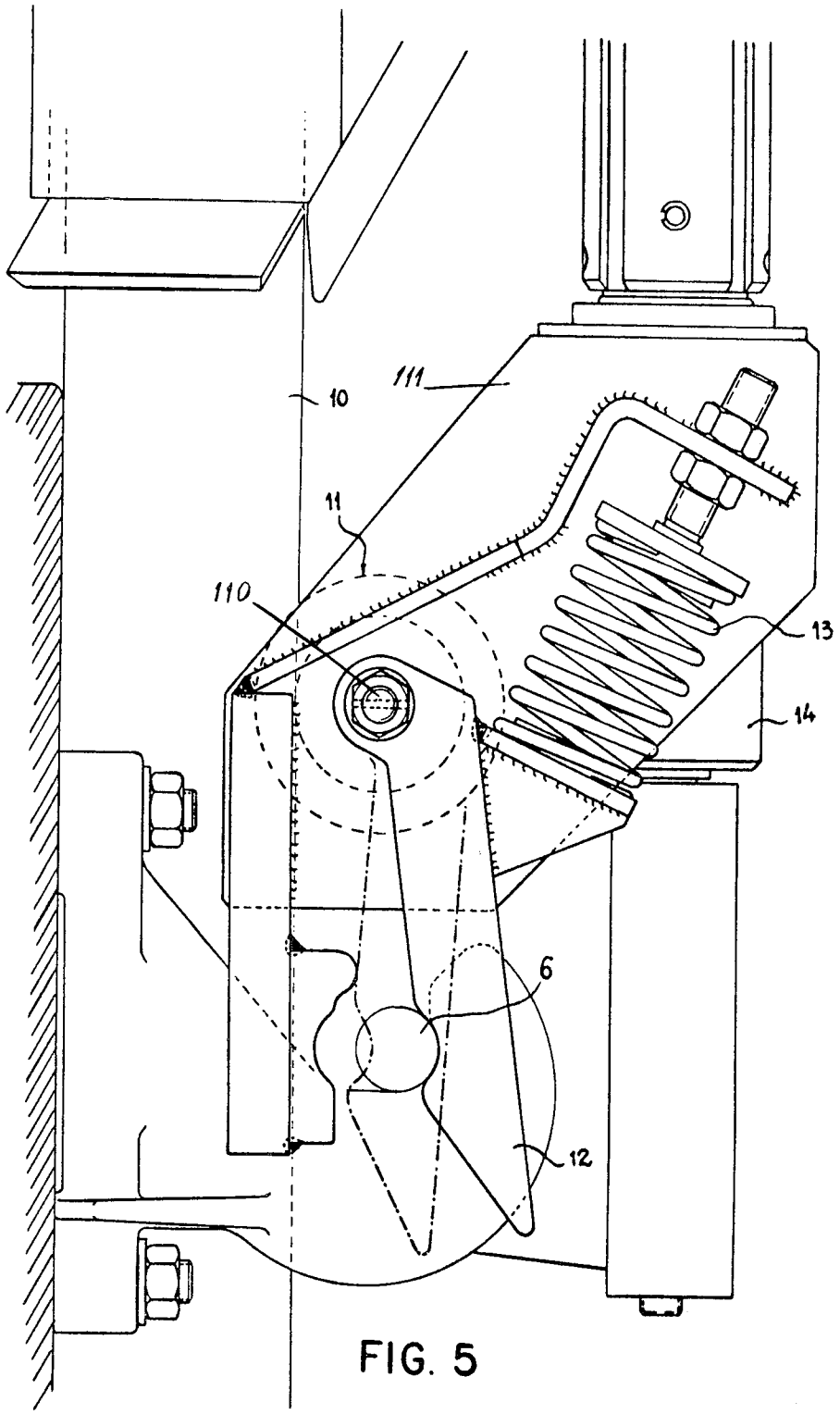


FIG. 5

FIG. 6

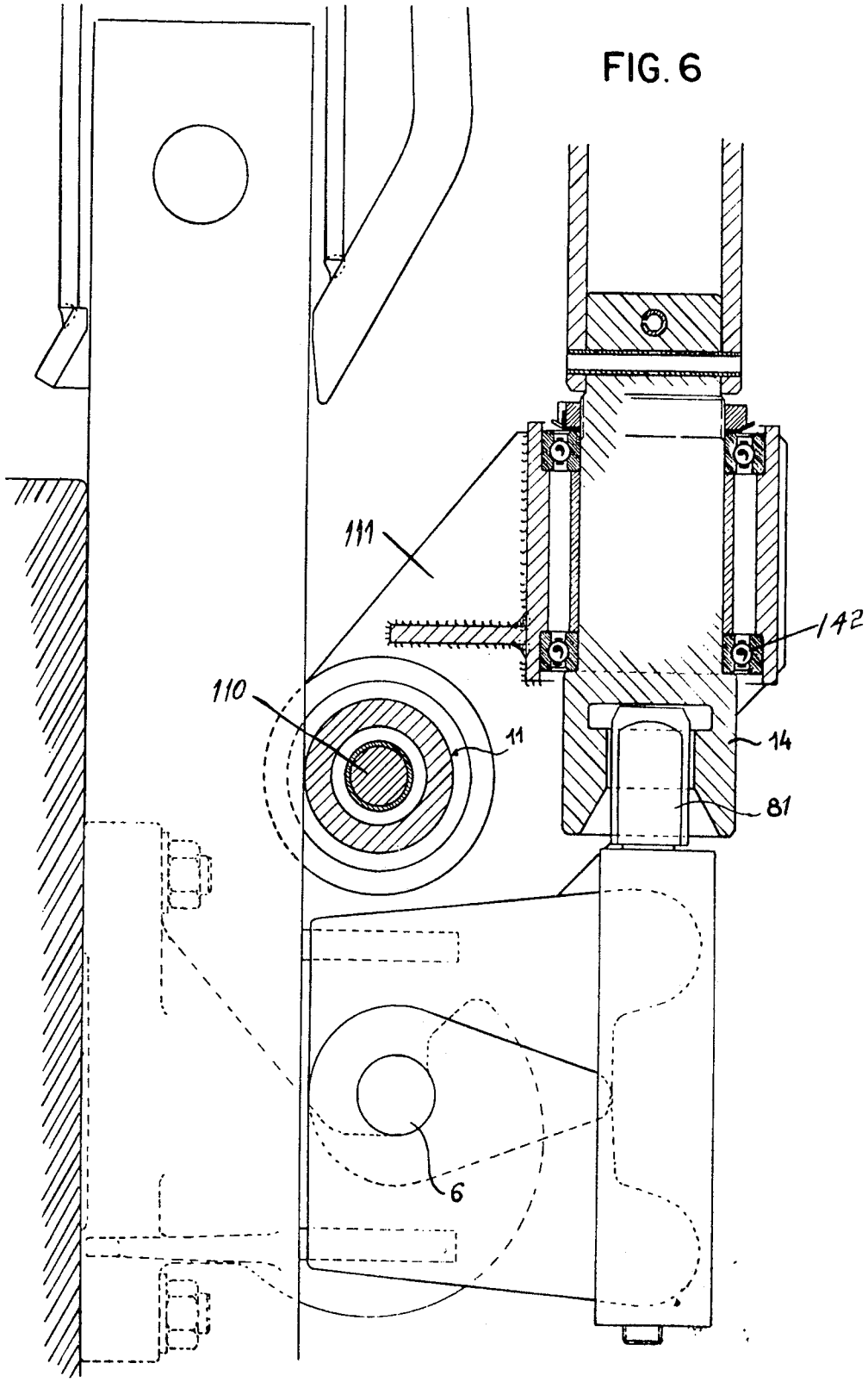
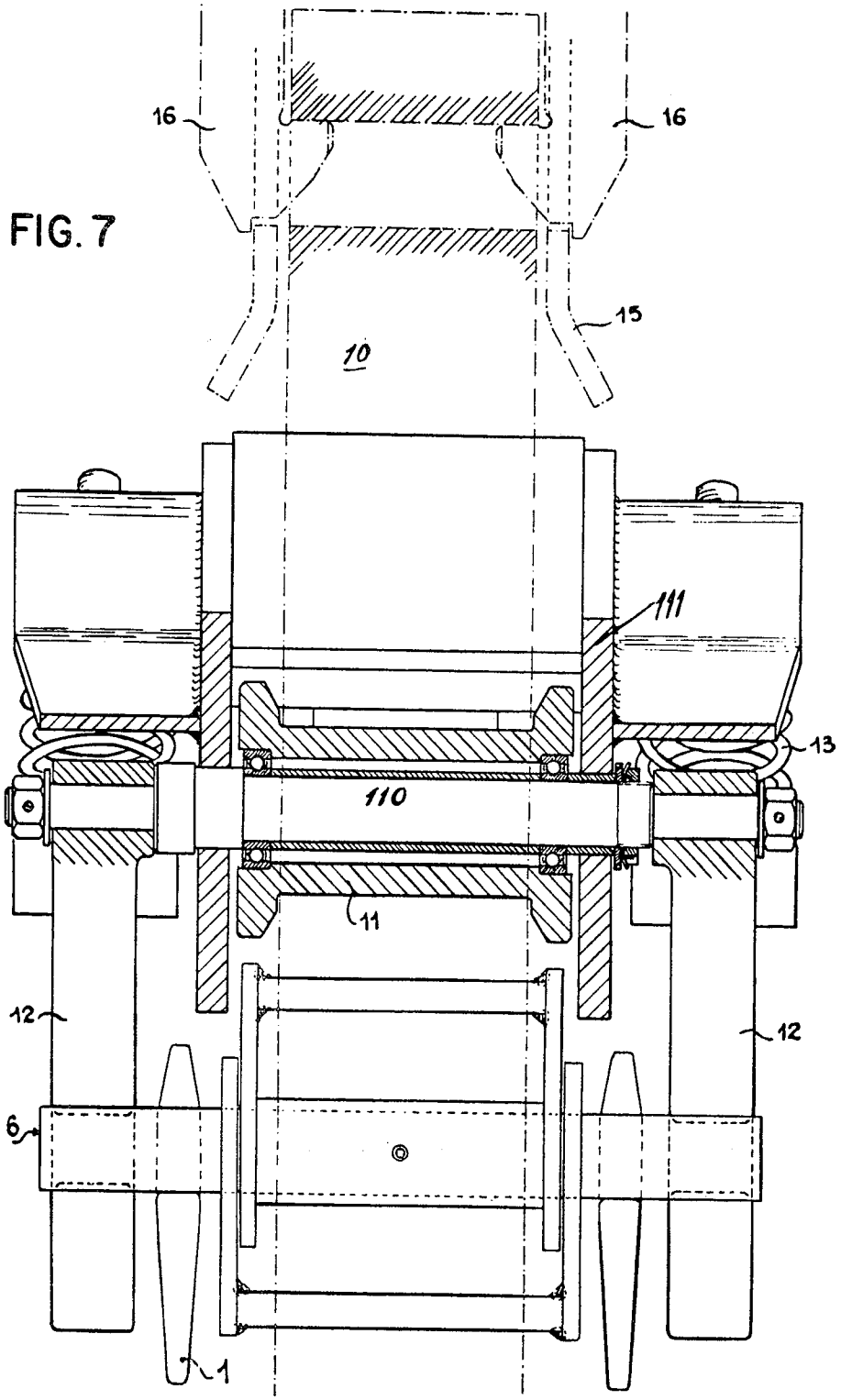


FIG. 7



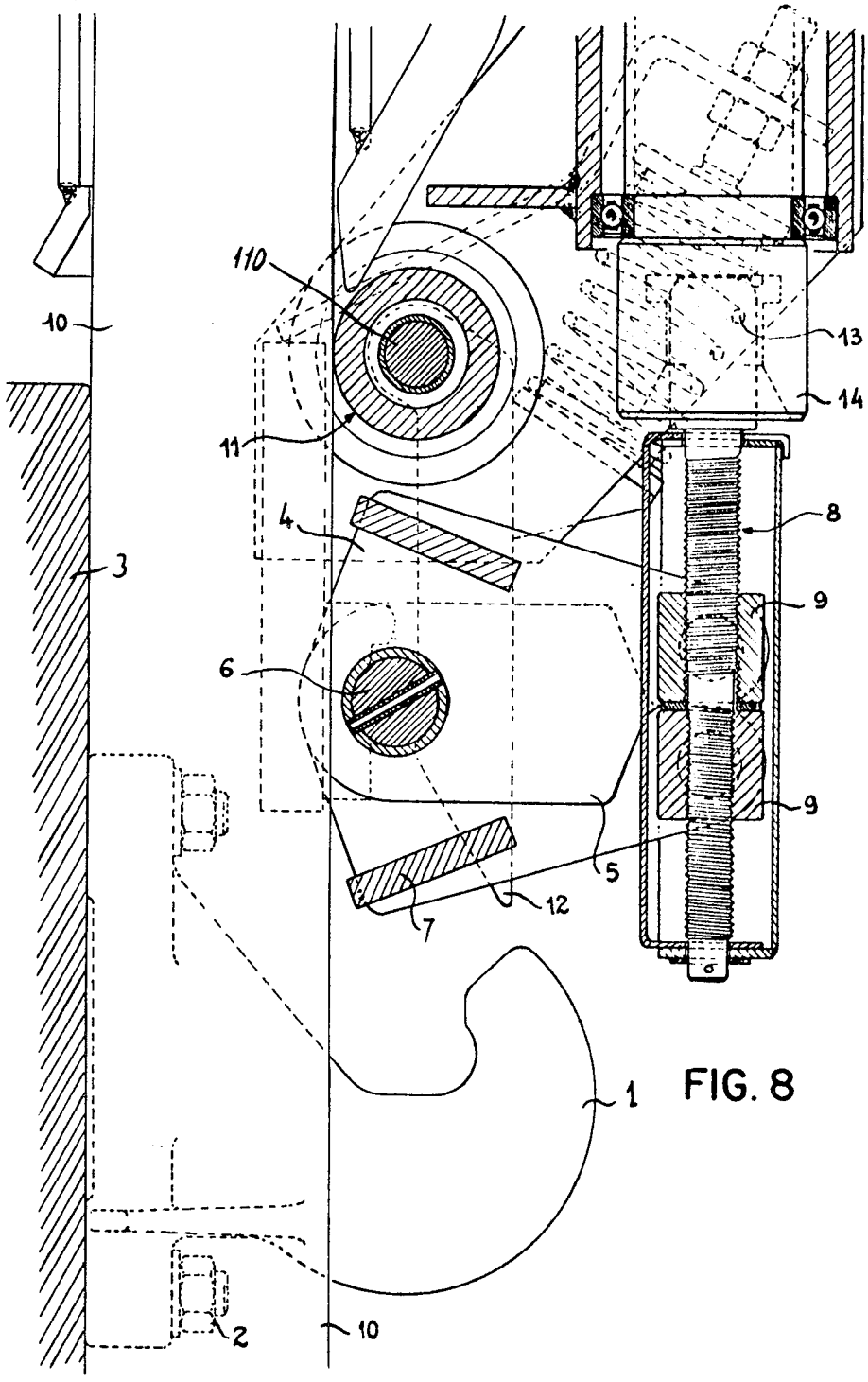
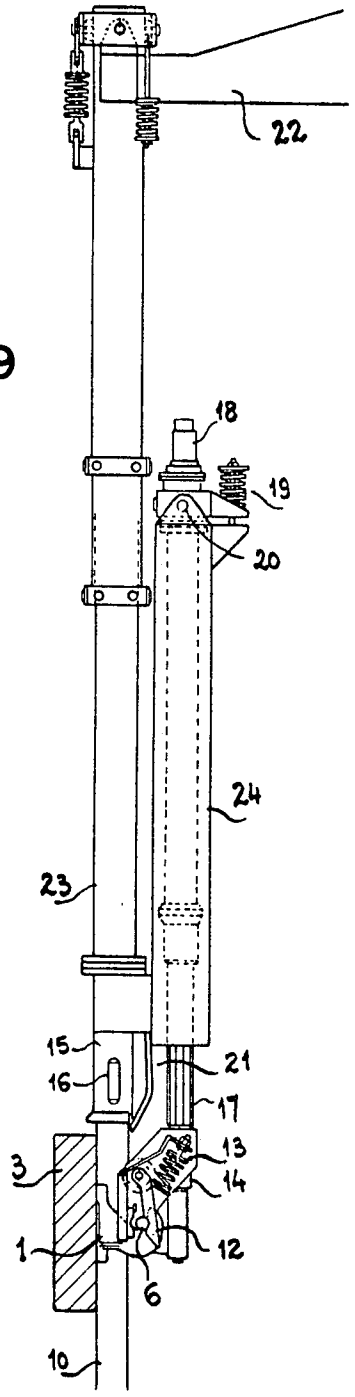


FIG. 8

FIG. 9



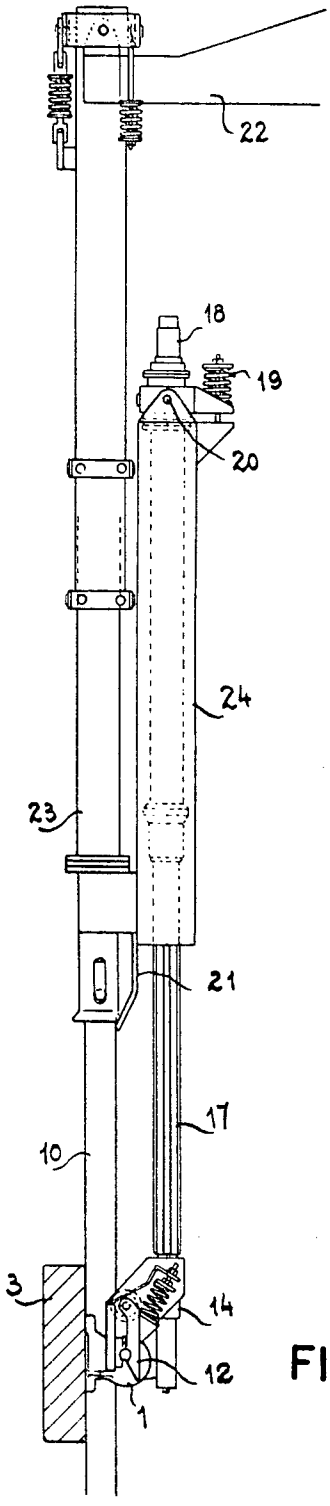


FIG. 10

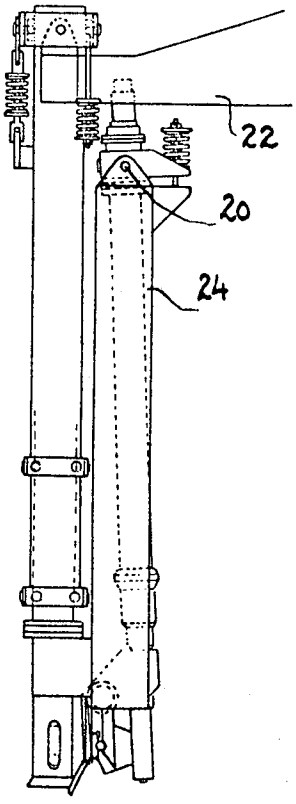


FIG. 11

ANODE ROD TIGHTENING APPARATUS FOR ALUMINA ELECTROLYSIS CELLS

This invention relates to an anode rod tightening system for use on main bars of alumina electrolysis cells of prebaked anode types.

In electrolysis cells which make use of prebaked anodes, the anodes are sealed at the lower portion of rods which are fixed by clamping onto the main horizontal bars to provide a rigid assembly which represents the anodic system.

The anodic system is actuated by vertical movement in a downward stroke to compensate for the spending of the anodes thereby to maintain the interpolar distance relatively constant.

The spending of the anodes requires replacement on the one hand and raising of the main bus bars when they arrive at the bottom end of their stroke by the above-mentioned movement, on the other hand. The raising of the bars should be performed without any movement of the anodes.

The changing of the anodes and the raising of the bus bars call for loosening of the connection rod—bus bars.

The tightening system of the rods on the main bus bars has a double purpose: to insure a satisfactory mechanical connection, and to perform an electrical contact for maintaining a very low-voltage drop under the action of the very high-intensity current passing through each anode. In modern cells, this intensity can reach oreven exceed 10,000 amperes.

Tightening the connection to a pressure of 12,000 to 15,000 daN is desired for such high-intensity currents. The tightening should, of course, be measured and controlled so as to maintain the desired uniformity.

Presently, there exist several types of clamping devices. Most of these are hand operated and procure insufficient tightening pressure as well as insufficient control of tightening pressure.

Certain hand operated systems include a removable part which has to be removed by hand to allow the extraction or setting of the anode rod.

Other systems do not have removable parts but include devices which can be swung aside to permit the removal of the anode rod. These systems are complex and quite expensive or badly arranged for mechanical operation both from the standpoint of changing of the anode and for raising the bus bars.

It is an object of this invention to provide a tightening system for the anode rods of the main bus bars of alumina electrolysis cells.

These and other objects and advantages of this invention will hereinafter appear and, for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawings, in which:

FIG. 1 is a side elevational view of the clamp embodying features of this invention, with the clamp shown in the tightened position;

FIG. 2 is a side elevational view similar to that of FIG. 1, showing the clamp in loosened position;

FIG. 3 is a front elevational view of the clamp shown in FIG. 1;

FIG. 4 is a plan view of the clamp shown in FIG. 1;

FIG. 5 is a side elevational view of the lower portion of the clamping device embodying the features of this invention;

FIG. 6 is a side elevational view, partially in section, of the upper portion of the clamp shown in FIG. 5;

FIG. 7 is a front view, partially in cross section, of the clamping device shown in FIGS. 5 and 6;

FIG. 8 is an elevational view, partially in section, of the lower portion of the driving mechanism installed on the clamping device;

FIG. 9 is an elevational view showing the assembly of the clamping and operating devices in mounted position;

FIG. 10 is an elevational view similar to that of FIG. 9 showing the devices in tightened position; and

FIG. 11 is an elevational view of the assembly in position after removal of a spent electrode.

The invention includes, on the one hand, a clamping device, and on the other hand, an operating mechanism. The clamping device is designed and built to apply very high-tightening pressure and to be controlled and operated by a special mechanism with tightening control. The operating mechanism is designed to operate efficiently and safely on the clamping device. The clamping device and the operating mechanism are designed to cooperate one with the other to provide a homogeneous assembly adapted to the various exacting requirements of operation.

The clamping device is also designed to facilitate its mechanical operation during raising of the bus bars. Finally, the clamping device is also arranged to operate in fitting relation with most efficient and economical shapes of anode rods.

The clamping device includes as essential elements two levers articulated on a common shaft, two-nut trunnions mounted respectively on each of the levers and a screw embodying separate portions having opposite threads (a right-hand thread and a left-hand thread), in operative engagement with the nuts to adjust the levers in a direction toward and away from each other. Each lever includes at least one jaw which applies pressure onto the anode rods when the levers are moved in the direction away from each other. The common shaft is supported on two hooks attached to the main bar and located on each side of the anode rod.

The operating mechanism includes as essential elements one double clamp capable of grasping the common shaft of the levers of the clamping device at each of its ends and which, for this purpose, extends further than the supporting hooks, a means of guiding along the anode rod, embodying for example a roller provided with flanges mounted on a shaft attached to a frame supporting the double clamp and the wrench and in which the frame is located at the end of a vertical ram which permits an up and down stroke.

For a particular arrangement of the system, the ram can be located along the centerline of the tightening wrench thereby to permit transmission of the last of its rotational movement. In this instance, the ram is movable both in its vertical stroke and in rotation and it can be telescopically arranged.

Referring now to the drawings for a detailed description, the device has for its purpose the tightening of an anode rod **10** on a main bus bar **3**. As shown in FIGS. **1–4**, a pair of hooks **1** are attached in laterally spaced apart relation on the main bus bar **3** as by means of bolts **2**. Levers **4** and **5** are articulated on a horizontally disposed shaft **6** which is supported at its ends on the two hooks **1**. In the tightened position, as shown in FIG. **1**, the levers **4** and **5** apply pressure by the action of jaw **7** on the anode **10**. A screw **8**, which includes two threaded portions, one a right-handed thread and another a left-handed thread, acts on nuts provided with trunnions **9** to actuate the levers **4** and **5**. The screw **8** is provided with a head **81** adapted to receive a tool for effecting turning movement.

In loosened position, shown in FIG. **2**, the nuts **9**, under the action of the opposite threads of the screw **8**, are brought together when the screw is rotated in the required direction. The screw **8** does not move vertically since its head **81** is maintained in the socket of a wrench that is provided on the driving mechanism. It appears that the pin **6** is displaced to the left relative to the position shown in FIG. **1**, which is necessary to disengage it from the hooks by a vertical stroke.

As shown in FIGS. **5** and **8**, the driving mechanism includes a double clamp **12** which is constantly urged towards closed position by a coil spring **13** and which is capable of grasping the pin **6** by each of its ends which, for this purpose, extend beyond the supporting hooks **1**; a tightening socket wrench **14** capable of acting on the head **81** provided on the double screw **8**; a tightening device along the anode rod **10** formed, for example, by a roller **11** provided with side flanges and mounted for rotational movement on a shaft **110** carried by a frame **111** which supports the double clamp **12** and the wrench **14**. The frame **111** is located at the end of a vertical ram **17** to permit its up and down stroke. The ram can advantageously be located along the centerline of the tightening wrench **14** so as to transmit, to the very end, its rotational movement. In this case, the ram is mounted for movement both in its vertical stroke and for rotation and it can be telescopically arranged.

As shown in FIG. 5, the driving mechanism, after having run along the anode rod 10 on roller 11, comes into position by clamping the movable jaws of the double clamp 12 onto pin 6. The jaws are tightened onto the pin by the coil spring 13.

The action of the spring can be, for example, completed by a small cylinder, not shown. The rotation of the wrench operates to loosen the clamping device and bring the pin 6 in the direction towards the left in FIG. 5 or in the direction towards the anode.

As shown in FIG. 6, the tightening wrench 14 includes a socket head 141 mounted to cooperate with the head 81 of the screw 8. The tightening clamp is mounted on bearings 142 to enable turning movement in the frame 111.

As shown in FIG. 7, the roller 11 is mounted on ball bearings and the jaws of the clamp 12 are articulated directly on the pin 110. A lifting bell 15 has been shown to cover the top of the anode rod 10 and to grasp it with hooks 16, for example.

FIG. 8 shows the device during its vertical stroke with the roller 11 turning on the anode rod 10 for guiding movement.

As shown in FIGS. 9–11, the vertical ram 17, with its operating parts, is articulated on a horizontal pin 20 parallel to the main bus bar 3 and supported by the lifting bell 15. A spring 13 engages the ram in a manner to hold the roller 11 in contact with the anode rod 10 and also against a slope provided for this purpose on the lifting bell 15 as the roller passes over the intermediate portion 21 integral with the lifting bell. The rotation of the wrench is actuated by a motor 18 which may be in the form of an electric, pneumatic or hydraulic motor.

This arrangement enables the device to advance while tightening itself successively on the rod 10 and the lifting bell 15 which, on the one hand, allows the device to be maintained along the lifting bell 15 and thus leaves the anode rod 10 completely free, and, on the other hand, it allows reset of the device with certainty on hooks 1 when operating in reverse, even in the case of lack of visibility.

The guiding ram 17 can be actuated in vertical movement by an electromechanical jack or a pneumatic or hydraulic cylinder 24.

FIG. 10 shows the assembly when the bus bar 3 is in its lowest position relative to the anode rod 10, with the clamping device in loosened position. FIG. 11 shows it in a position after removal of a spent anode and before grasping a new anode. The driving mechanism keeps the clamping device set back in place after the setting of a new anode in the cell.

In FIGS. 8–11, the system is shown as being attached onto a machine having for one of its functions the change of spent anodes. The system is suspended from the end of a rigid horizontally disposed arm 22 with the lifting bell 15 being fixed, for example, to the end of the guiding ram 23 adapted to be actuated in a vertical direction by a cylinder. The pin 21 is attached to the upper portion of the two vertical arms integral with the lifting bell 15.

It will be seen that the screw 8, which actuates the clamping device, is vertically disposed such that a vertical traveling movement is sufficient to place the socket onto the head of the screw to permit rotational movement thereof.

It will be seen that the system described is applicable to the clamping of anode rods of electrolysis cells onto the main bus bars which support the anodes.

It will be understood that changes may be made in the details of construction, arrangement and operation, without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. An anode rod tightening apparatus for alumina electrolysis cells having main bus bars comprising the combination of a clamping device and a driving mechanism for the clamping device, said clamping device comprising a horizontally disposed shaft, a pair of levers articulated on said shaft, an elongate screw member having one portion with a right-hand thread and another portion with a left-hand thread, a nut member mounted respectively on each of the levers with one nut member threadably engaging one of the threaded portions and the other nut member engaging the other of the threaded portions of said screw for displacement of the levers in the direction toward and away from each other responsive to turning movement of said screw, a jaw member on each lever in pressure engagement with an anode rod when the levers are apart, hooks mounted in laterally spaced apart relation on the bus bars for supporting the shaft, said driving mechanism comprising a double clamp for engaging laterally spaced apart portions of the shaft, a wrench vertically disposed relative the screw and mounted for vertical movement into and out of engagement with the screw and for turning movement for rotating the screw when in operative engagement therewith, and a guide means along the rod for guiding the driving mechanism.

2. An apparatus as claimed in claim 1 in which the hooks are located on each side of an anode rod when in position of use.

3. An apparatus as claimed in claim 1 which includes a frame and in which the guiding system of the driving mechanism comprises a roller having side flanges and mounted for rotational movement on the frame and in which the frame supports the double clamp and wrench.

4. An apparatus as claimed in claim 1 which includes a guiding ram aligned with the axis of the tightening wrench and mounted for transmission of rotational movement to the wrench.

5. An apparatus as claimed in claim 4 in which the guiding ram includes a horizontal pin parallel to the main bus bar and on which the ram is articulated for rocking movement, and a spring resiliently urging the guiding system into engagement with the anode rod.

6. An apparatus as claimed in claim 4 in which the guiding ram is telescopic.

7. An apparatus as claimed in claim 5 in which the anode rod has an extension in the form of a slope and which includes a lifting bell having an intermediate portion connected to the slope.

8. An apparatus as claimed in claim 7 which includes a horizontal pin carried by the lifting bell and on which the guiding ram is pivotally mounted.

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