April 24, 1962 H. HOFMEISTER 3,031,177

ROTARY CONVERTER ARRANGEMENTS

Filed Sept. 8, 1958 2 Sheets-Sheet 1

FIG. 1

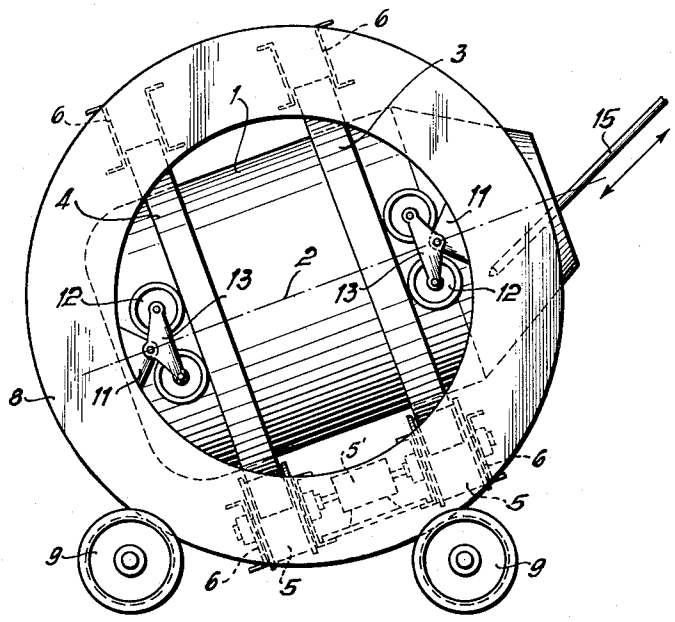
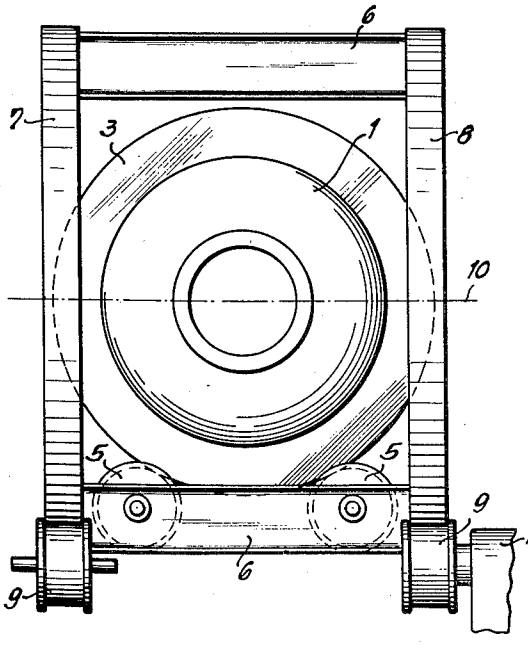


FIG. 2



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FIG. 3

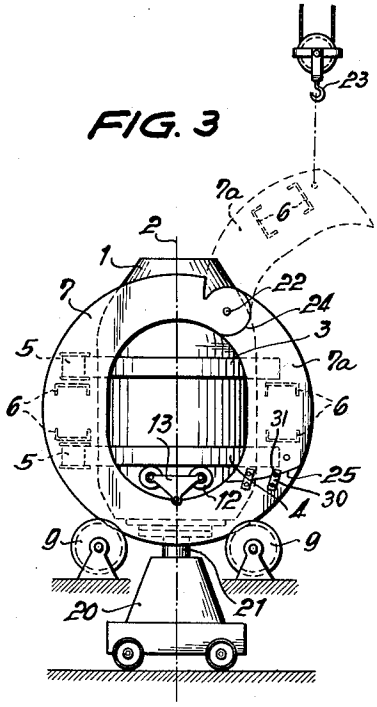


FIG. 4

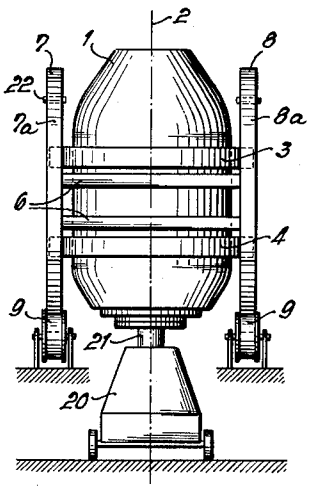
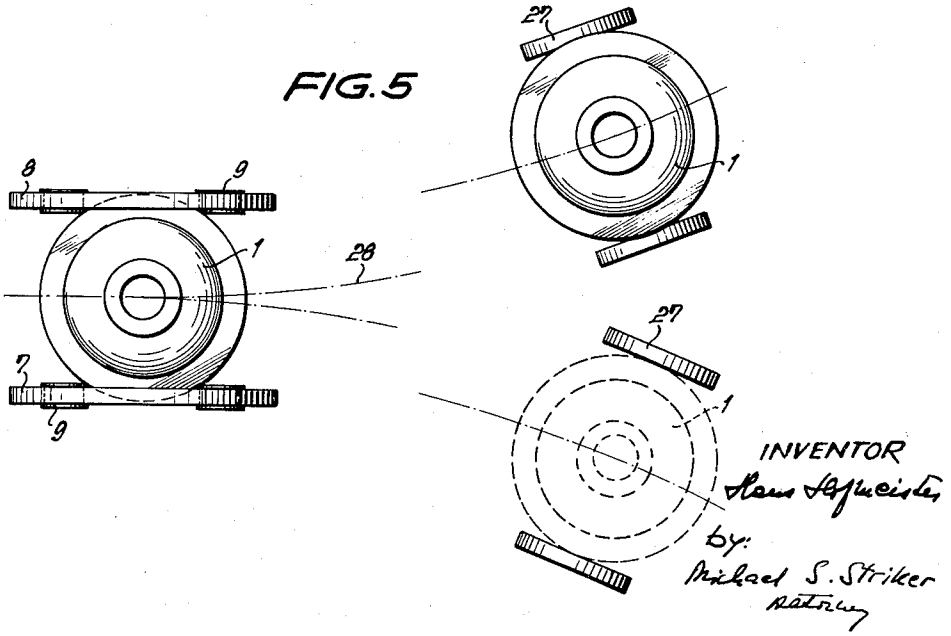


FIG. 5



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ROTARY CONVERTER ARRANGEMENTS

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The present invention relates to converters in which iron is converted into steel.

More particularly, the present invention relates to rotary converters where the container in which the converter reactions take place continuously rotates about its axis during operation of the converter.

Conventional rotary converters require massive supports to carry the converter and support the same for rotation. Such massive supports are necessary because of the great forces which must be resisted by these supports. These conventional massive supports have many disadvantages. They are extremely expensive because they require extremely large castings, forgings, or the like. Because of their great weight they are moved only with the use of great amounts of power. The rotary container itself is made substantially inaccessible, for the purposes of observation and repair, by such massive supports. For example, when a part of the lining of the rotary container becomes worn excessively so that such a part of the container glows, it is difficult for the operator to observe such glowing with the conventional massive supports for the rotary container. Furthermore, the rotary container is for all practical purposes irremovably connected with the massive supports so that it is extremely difficult to clean such a container uniformly with the result that deposits on the walls of the container do not have uniform thickness so that unbalanced forces occur during rotation of the container. Also, the extremely long cooling period required before the container can be relined or otherwise repaired greatly cuts down the rate of production whenever maintenance is necessary.

One of the objects of the present invention is to provide in a rotary converter arrangement a container supporting structure which is relatively light while at the same time having the desired strength and which renders all parts of the container visible and easily accessible so that the above drawbacks are eliminated.

Another object of the present invention is to provide a container supporting structure which is made up in its entirety of metal members conventionally supplied by rolling mills, so that it is unnecessary to make special castings or forgings for the support structure of the present invention.

A further object of the present invention is to provide a rotary converter arrangement which renders it possible for one container to be removed quickly and easily from its supporting structure and to be replaced by a fresh container, so that the operations may continue with only an extremely short interruption in the operations, the removed container being repaired while the operations continue with the replacement container.

An additional object of the present invention is to provide structure capable of accomplishing all of the above objects and at the same time made up of simple, ruggedly constructed elements which are very reliable in operation.

With the above objects in view, the present invention includes in a rotary converter arrangement a container having an axis of rotation and in which the converter reactions take place and a cage means supporting the container for rotation about this axis. In accordance with the present invention this cage means includes a pair of rigid side members respectively located at opposite sides of the container and a plurality of beams extending between and fixed to the side members.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a partly schematic side elevational view of a rotary converter arrangement according to the present invention with the axis of rotation of the rotary converter extending upwardly toward the right, as viewed in FIG. 1;

FIG. 2 is an end view of the structure of FIG. 1 as seen from the right side of FIG. 1 with the axis of rotation horizontal and without a tube shown in FIG. 1 for supplying oxygen to the interior of the container, FIG. 2 also showing fragmentarily part of a drive for controlling the inclination of the axis of rotation;

FIG. 3 is an elevational view showing diagrammatically structure which makes it possible to remove one container from a cage means of the invention and to replace this container with a new container;

FIG. 4 shows the structure of FIG. 3 as seen from the right side of FIG. 3; and

FIG. 5 is a diagrammatic top plan view diagrammatically showing a track construction as well as diagrammatically illustrating the movement of the containers between the cage means of the present invention and supporting frames at which repairs are made.

Referring now to the drawings, and to FIGS. 1 and 2 in particular, the rotary converter arrangement of the present invention includes a container 1 having an axis of rotation 2 which coincides with the central longitudinal axis of the elongated container 1 in which the converter reactions take place. A pair of rings 3 and 4 surround and are fixed to the container 1 and are spaced from each other along the axis 2, these rings having a common axis which coincides with the axis 2.

In accordance with the present invention, the container 1 is supported for rotation by a cage means which includes a pair of rigid side members 7 and 8 respectively located in parallel vertical planes at opposite sides of the container 1 and a plurality of beams 6 extending between and fixed to the side members 7 and 8, so that in this way the parts 6—8 form a light but nevertheless very strong rigid framework of the cage means. It will be noted from FIG. 1 that when the axis of rotation 2 is horizontal or substantially horizontal, then some of the beams 6 are located above the container 1 and two pairs of beams 6 are located beneath the container 1. A pair of rollers 5 are turnably carried by and between each of these lower pairs of beams 6, and the ring 4 rests on one of the pairs of rollers while the beam 3 rests on the other of the pairs of rollers 5. A driving motor 5' is supported between the two pairs of beams 6 and operatively connected with one pair of coaxial rollers 5, as diagrammatically illustrated in FIG. 1, so that the motor 5' serves to drive at least one pair of the rollers 5 in order to maintain the container 1 continuously rotating about its axis 2 during operation, this motor 5' being supplied with current from any suitable source.

The beams 6 are conventional rolled U-beams, for example, which are readily available, and the rigid side members 7 and 8 are in the form of relatively thick annular plates which may be cut, by burning, for example, from strong thick metal plates which are also readily available since they are conventionally supplied by rolling mills. The ends of the beams 6 may be welded to the plates 7 and 8 so as to provide an extremely strong but light framework for the cage means of the invention.

As is apparent from FIGS. 1 and 2, the outer periphery of each of the annular side plates 7 and 8 rest by gravity on a pair of rollers 9 supported for rotation about sta-

tionary axes, respectively. At least one of the rollers **9** is capable of being driven by a motor **14** or the like, fragmentarily illustrated in FIG. 2, so that the rollers **9** through their frictional engagement with the plates **7** and **8** are capable of controlling the inclination of the axis **2**. Thus, the rollers **9** can turn the entire structure to any desired angular position with respect to the axis **10** shown in FIG. 2, while the rollers **5** turn the container **1** about the axis **2** which is normal to the axis **10**.

As is apparent from FIG. 1 the rings **3** and **4** have inner side faces directed toward each other and outer side faces directed away from each other, and a pair of rollers **12** are in engagement with each of the outer side faces of the rings **3** and **4**. Each pair of rollers **12** is turnably supported by a member **13** which is in turn pivotally connected with a bracket **11** fixed to the ring **8**, so that the parts **11–13** cooperate with the rings **3** and **4** to substantially prevent axial movement of the container **1**. The ring **7** may also be provided with parts **11–13** cooperating with the rings **3** and **4** in the manner shown in FIG. 1.

During the actual converting process, an elongated tube **15** extends through the open right end of the container **1** into the interior of the latter to supply oxygen. This tube **15** is purely conventional and can be moved away from the container **1**, which continuously rotates during the converting process. The rollers **9** serve to place the container **1** at the different inclinations required for charging the container, for blowing, for slag removal, for emptying the container, and the like. The reactions which take place in the converter are conventional, and in this connection reference may be had to chapter VI of "Engineering Metals and Their Alloys" by Carl H. Samans, published by the Macmillan Company in 1952. Instead of a friction drive between the rollers **9** and plates **7** and **8**, the rollers **9** may be in the form of gears meshing with teeth at the outer periphery of the annular plates **7** and **8**. The annular configuration of the rigid members **7** and **8** in addition to reducing the weight of the structure without sacrificing strength produces the advantages of providing an extremely compact arrangement since the rings **3** and **4** extend into the spaces surrounded by the annular plates **7** and **8**, rendering all parts of the container **1** easily visible so that localized glowing will be easily and quickly detected, and rendering all parts of the assembly easily accessible so that lubricating and other maintenance operations can be comfortably and quickly carried out.

In the embodiments of FIGS. 3–5 the ring members **7** and **8** respectively have portions **7***a* and **8***a* which are aligned with each other and carry the beams **6** which are located at one side of the container **1** when its axis is vertical as shown in FIG. 3. The portions **7***a* and **8***a* are pivotally connected respectively to the remainder of members **7** and **8** by a pair of pivot pins **22** so that these portions **7***a* and **8***a* together with the beams **6** connected therewith may be turned from the solid active position shown in FIG. 3 to the dotted inactive position by the use of a suitable crane **23** or the like. The curved surfaces **24** and **25** at which the portions **7***a* and **8***a* have sliding engagement with the remainder of members **7** and **8** extend along circles whose centers are in the axis of the pivot pins **22**. The right beams **6** of FIG. 3 prevent horizontal movement of the container **1** to the right, as viewed in FIG. 3, away from the cage means, when these beams **6** and the portions **7***a* and **8***a* are in the active solid position of FIG. 3. Any suitable lock devices such as one or more plates **30** and pins **31** may be used for releasably holding the portions **7***a* and **8***a* in their active solid positions shown in FIG. 3. When it is desired to remove the container **1** from the cage means, the upper pins **31** of FIG. 3 are removed, and then through the use of the crane **23**, for example, the portions **7***a* and **8***a* together with the right beams **6** of FIG. 3 may be turned to the upper dotted inactive position shown in FIG. 3, and at this time the right beams **6** are no longer in a position preventing movement of the container **1** horizontally to the right, as viewed in FIG. 3.

The rings **7** and **8** will be turned by the rollers **9** to locate the container **1** in the vertical position shown in FIGS. 3 and 4 with the open end of the container **1** located at the uppermost part thereof, prior to removal of the container **1** from the cage means.

A transporting means is provided for transporting the container **1**, and in the illustrated example this transporting means takes the form of a carriage **20** guided for movement along tracks **28** shown diagrammatically in FIG. 5, and the carriage **20** is provided with a hydraulic lifting device **21** or the like which engages the bottom end of the container **1** to raise the latter slightly so that it no longer rests on the rollers **12** shown in FIG. 3. In this embodiment only one pair of rollers **12** are provided adjacent the lower part of each plate **7** and **8**, as viewed in FIG. 3. Thus, with the container supported in this way by the carriage **20**, it is possible to move the latter together with the container **1** carried thereby along the track **28** to the right to the upper supporting frame **27** diagrammatically illustrated in FIG. 5. At this supporting frame the container **1** may remain as long as desired so that it can cool to the desired extent and so that repairs such as removal of the old lining and replacement with a new lining may be carried out.

In the meantime, however, operations need not stop. At the lower supporting frame **27** diagrammatically shown in FIG. 5 is located a new or already repaired container **1** which can be immediately moved to the cage means to be operatively connected therewith. For this purpose the track **28** is forked in the manner shown diagrammatically in FIG. 5 and the same carriage **20** used for the upper container **1** shown at the right of FIG. 5 or another carriage **20** may be used to transport the lower container shown at the right of FIG. 5 in dotted lines to the cage means to be connected therewith by lowering of portions **7***a* and **8***a* back to their solid line position shown in FIG. 3. Any conventional track switches may be used to optionally connect the two converging portions of track **28** shown in FIG. 5 with the portion of this track which is directly beneath the container **1**. For example at the intersection of the branches of the forked track the latter may be provided with a turnable track portion having a turning axis coinciding with the vertical axis **2** and turnable between positions optionally connecting either of the branches with the track portion shown at the extreme left of FIG. 5. Thus, with the embodiment of FIGS. 3–5 an interruption in the operations of minimum duration will result when it is required to carry out extensive maintenance or repair operations on a container **1**. Instead of providing the carriage **20** with a hydraulic jack **21** or other lifting device, it is possible to lower the container to and raise it from the carriage **20** by eccentric or wedge devices which cooperate with the rollers **12** or with the roller carriers **13** to raise and lower the latter so that in this way the container itself is raised and lowered.

Where the rings **3** and **4** do not extend into the spaces surrounded by the annular plates **7** and **8**, then it is possible to render the container **1** removable from the cage means simply by connecting the right beams **6** of FIG. 3 removably with the annular plates **7** and **8** by any suitable bolts or the like. Also, even where the rings **3** and **4** extend into these spaces, the container may be removed from the cage means if the portions **7***a* and **8***a* together with the beams **6** connected thereto are removable from the remainder of plates **7** and **8** instead of being pivotally connected therewith, although this latter construction which is shown in FIGS. 3 and 4 is preferred since it makes the removal and replacement of the container far quicker and easier to carry out.

It will be noted that in the embodiment of FIGS. 3 and

4 only two beams 6 are located at each side of the axis 2, and if desired only two beams 6 may be located at each side of the axis 2 in the embodiment of FIGS. 1 and 2.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of converts differing from the types described above.

While the invention has been illustrated and described as embodied in rotary converters, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a rotary converter arrangement, in combination, a converter having a main axis; cage means including two cage members located on opposite sides of said converter extending in planes parallel to said main axis of said converter, said cage means being open on at least one side so as to permit removal of said converter from said cage means through said open side thereof; first supporting means on said cage means and corresponding engaging means on said converter supporting said converter in said cage means rotatably about said main axis thereof; second supporting means supporting said cage means together with said converter turnably about an axis intersecting said main axis of said converter and extending normal thereto; third supporting means mounted on each of said cage members and supporting said converter means in direction of said main axis of the same and movable in a transverse direction transverse to said main axis and parallel to said planes of said cage members; and blocking means mounted on said cage means movable between a blocking position preventing removal of said converter through said open side of said cage means and a releasing position permitting such removal in said transverse direction, if desired.

2. In a rotary converter arrangement, in combination, a converter having a main axis; cage means including two cage members located on opposite sides of said converter extending in planes parallel to said main axis of said converter, said cage means being open on at least one side so as to permit removal of said converter from said cage means through said open side thereof; first supporting means on said cage means including roller means and correspondingly circular engaging means on said converter in rolling contact with said roller means for supporting said converter in said cage means rotatably about said main axis thereof; second supporting means supporting said cage means together with said converter turnably about an axis intersecting said main axis of said converter and extending normal thereto; third supporting means mounted on each of said cage members and supporting said converter means in direction of said main axis of the same and movable in a transverse direction transverse to said main axis and parallel to said planes of said cage members; and blocking means mounted on said cage means movable between a blocking position preventing removal of said converter through said open side of said cage means and a releasing position permitting such removal in said transverse direction, if desired.

3. In a rotary converter arrangement, in combination, a converter having a main axis; cage means including two cage members located on opposite sides of said converter extending in planes parallel to said main axis of said converter, said cage means being open on at least one side so as to permit removal of said converter from said cage means through said open side thereof; first supporting means on said cage means including beam means extending between said cage members on the other side of said cage means perpendicular to said planes and to said main axis, roller means mounted on said beam means, and corresponding circular engaging means on said converter in contact with said roller means for supporting said converter in said cage means rotatably about said main axis thereof; second supporting means supporting said cage means together with said converter turnably about an axis intersecting said main axis of said converter and extending normal thereto; third supporting means mounted on each of said cage members and supporting said converter means in direction of said main axis of the same and movable in a transverse direction transverse to said main axis and parallel to said planes of said cage members; and blocking means mounted on said cage means movable between a blocking position preventing removal of said converter through said open side of said cage means and a releasing position permitting such removal in said transverse direction, if desired.

4. In a rotary converter arrangement, in combination, a converter having a main axis; a pair of guide rings secured to said converter and having circular guide faces concentric with said main axis; cage means including two cage members located on opposite sides of said converter extending in planes parallel to said main axis of said converter, said cage means being open on at least one side so as to permit removal of said converter from said cage means through said open side thereof; beam means extending between said cage members on the other side of said cage means and across said converter; roller means mounted on said beam means and being in rolling engagement with said circular guide faces of said guide rings for supporting said converter in said cage means rotatably about said main axis thereof; second supporting means for supporting said cage means together with said converter turnably about an axis intersecting said main axis of said converter and extending normal thereto; third supporting means mounted on each of said cage members and supporting said converter means in direction of said main axis of the same and movable in a transverse direction transverse to said main axis and parallel to said planes of said cage members; and blocking means pivotally mounted on said cage means for movement between a blocking position preventing removal of said converter through said open side of said cage means, and a releasing position permitting such removal in said transverse direction, if desired.

5. In a rotary converter arrangement, in combination, a converter having a main axis; a pair of guide rings secured to said converter and having first cylindrical guide faces concentric with said main axis and second circular guide faces perpendicular to said main axis; cage means including two cage members located on opposite sides of said converter extending in planes parallel to said main axis of said converter, said cage means being open on at least one side so as to permit removal of said converter from said cage means through said open side thereof; beam means extending between said cage members on the other side of said cage means and across said converter and being located between said second confronting guide faces; roller means mounted on said beam means and being in rolling engagement with said first cylindrical guide faces of said guide rings for supporting said converter in said cage means rotatably about said main axis thereof; second supporting means for supporting said cage means together with said converter turnably about an axis intersecting said main axis of said converter and extending normal thereto; a pair of supporting rollers having axes perpendicular to said parallel planes mounted on each of said cage members in rolling contact with said second circular guide faces and

supporting said converter means in direction of said main axis of the same and turnable about said main axis and movable in a transverse direction transverse to said main axis and parallel to said planes of said cage members; and blocking means pivotally mounted on said cage means for movement between a blocking position preventing removal of said converter through said open side of said cage means, and a releasing position permitting such removal in said transverse direction, if desired, said blocking means including a blocking beam extending in said blocking position through said open side of cage means across said converter and between said guide rings, said blocking beam being located above said converter when the same and said main axis are vertical.

6. In a rotary converter arrangement, in combination, converter means having a main axis and circular surface means concentric with said main axis; means for rotating said converter means about said main axis; cage means having a pair of circular support faces concentric with a common axis extending in a first direction perpendicular to the same, said cage means including a main part and at least two confining means located on opposite sides of said converter means and extending in said first direction transverse to said main axis, said confining means cooperating with said circular surface means for guiding said container means during rotation of the same about said main axis while blocking movement of said converter means in a second direction transverse to said main axis and to said first direction, one of said confining means being pivotally mounted on said main part for movement between a confining position and a non-confining position retracted from the respective side of said converter means so that the same is free to move in said second transverse direction away from the other confining means whereby said converter means can be removed from said cage means; a pair of supports on said main part for supporting said converter in axial direction and being disposed and spaced from each other to permit movement of said converter means in said second transverse direction; means for securing said one confining means in said confining position to said main part; and means in rolling contact with said circular support faces of said cage means for supporting said cage means during turning movement about said common axis.

7. In a rotary converter arrangement, in combination, converter means having a main axis and circular surface means concentric with said main axis and perpendicular thereto; means for rotating said converter means about said main axis; cage means having a pair of circular support faces concentric with a common axis extending in a first direction perpendicular to said main axis, said cage means including a main part and at least two confining means located on opposite sides of said converter means and extending in said first direction transverse to said main axis, said confining means cooperating with said circular surface means for guiding said container means during rotation of the same about said main axis while blocking movement of said converter means in a second direction transverse to said main axis and to said first direction, one of said confining means including a beam means located on one side of said container means for confining the same, a pair of support portions secured to the ends of said beam means, and pivot means supporting said support portions on said main part for turning movement with said beam means about a pivot axis parallel to said common axis between a confining position and a non-confining position retracted from the respective side of said converter means in which said beam means is located above said converter means when the same and said main axis are vertical so that said converter means is free to move in said second transverse direction away from the other confining means; means for securing said support portions in said confining position to said main part; and means in rolling contact with said circular support faces of said cage means for supporting said cage means in axial direction during turning movement about said common axis and movable in said second transverse direction in such a manner that said converter means can be removed in said second transverse direction out of said cage means in said non-confining position of said one confining means.

8. In a rotary converter arrangement, in combination, converter means including a converter having a main axis and a pair of rings secured to and surrounding said converter, said rings having cylindrical surfaces, and circular surfaces perpendicular to said main axis and including confronting circular surfaces, said surfaces being concentric with said main axis of said converter means; cage means including a pair of parallel cage members located on opposite sides of said converter means and extending in planes parallel to said main axis of said converter means, said cage members having circular faces concentric with a common axis intersecting said main axis and extending normal thereto, said cage means including first beam means and second beam means extending on opposite sides of said converter means parallel to said common axis between said cage members and having ends secured to the same, said beam means being located between said confronting surfaces of said rings, each of said cage members including a main part supporting said first beam means and a second movable part pivotally mounted on said main part and supporting the second beam means, so that said second beam means can be moved with said movable parts from its normal blocking position extending across said converter means and blocking transverse movement of the same to a retracted releasing position permitting movement of said converter means away from said first beam means and out of said cage means; means for securing said second movable part to said main parts when second beam means is in said normal blocking position; first roller means mounted on said first beam means in rolling contact with said cylindrical surfaces of said rings and including drive roller means for rotating said converter means about said main axis; second roller means in rolling contact with said circular faces of said cage members for rotatably supporting said cage means together with said converter means about said common axis; and third roller means having axes perpendicular to said parallel planes mounted on each of said cage members and in rolling engagement with at least one of said perpendicular circular surfaces of said rings for supporting said converter means in axial direction and being spaced to permit movement of said converter means out of said cage means in a direction transverse to said main axis and parallel to said parallel cage members.

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