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(72) Inventors:
• ROSE, William, M.
59140 Dunkerque (FR)
• VERRELLE, Dominique
5832 Fentange (LU)

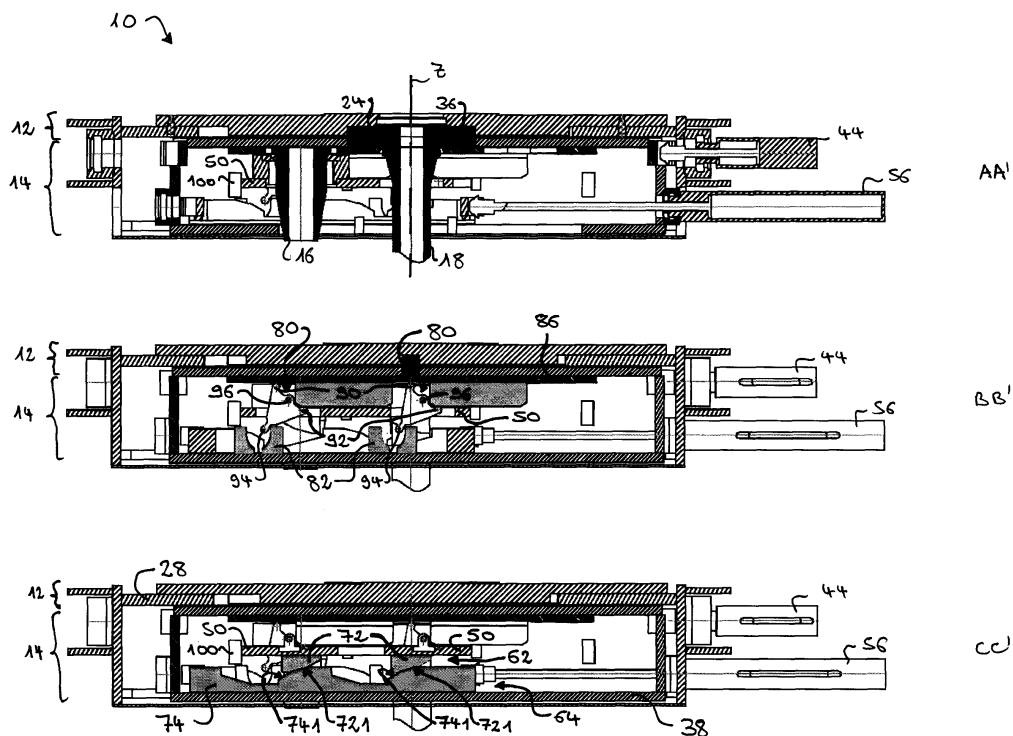
(71) Applicant: TECH-GATE S.A.
5832 Fentange (LU)

(74) Representative: Schmitt, Armand et al
Office Ernest T. Freylinger S.A.,
B.P. 48
8001 Strassen (LU)

(54) A sliding gate valve for a metallurgical vessel

(57) A sliding gate valve 10 comprising a flow regulating means 12, a short length refractory outlet tube 16 and an additional long length refractory flow protection tube 18. A mechanism 14 is provided for bringing, as required, either the outlet tube 16 or the flow protection tube 18 from a parking position into an operative position below the flow regulating means 12, respectively from

the operative position into the parking position. The mechanism 14 supports the short length refractory outlet tube 16 and the long length refractory flow protection tube 18 side by side. When positioned, the long length refractory flow protection tube 18 assumes the function of a ladle shroud and the short length refractory outlet tube 16 assumes the function of a collector nozzle.



- Fig. 3 -

Description

Introduction

[0001] The present invention relates to a sliding gate valve for a metallurgical vessel.

[0002] Sliding gate valves are used in metallurgy to open or shut a pouring orifice of a metallurgical vessel such as a teeming ladle or a tundish. Sliding gate valves allow to control the rate of flow of molten metal by variation of the flow passage aperture. A typical application is continuous casting of steel, where molten steel is transferred at a desired rate from a tundish into a continuous casting mould.

[0003] Generally, two different types of sliding gate valves can be distinguished. In so called three plate sliding gate valves, a slide plate is moveably arranged in between an upper and a lower fixed plate the latter two being stationary with respect to the vessel. Each plate has an orifice and those of the stationary plates are coaxial. The position of the orifice in the slide plate relative to the coaxial orifices determines the flow passage aperture and thus the flow rate. In the second type of sliding gate valves, the lower stationary plate is omitted, the working principle of the sliding gate valve however remains the same.

[0004] Downstream of the sliding gate valve, the molten metal flow is confined by pouring tubes made of refractory material. A collector nozzle, i.e. a short length refractory tube, is connected immediately to the bottom plate of the sliding gate valve. The collector nozzle confines the molten metal flow and protects the sliding gate valve from damage caused by thermal wear or splashing. Whenever protection of the molten metal flow itself is desirable, a ladle shroud, i.e. an elongated refractory tube (also called immersion nozzle), is connected in series downstream of the collector nozzle. In use, the ladle shroud extends below the level of molten metal in the receiving mould to protect the molten metal stream. This is generally the case in continuous casting of steel. As a result, oxidation, non-metallic inclusion and occurrence of turbulent flow and splash are avoided. Whenever access to the orifices is required, for example to remove hardened metal clogging the valve or the vessel outlet, the ladle shroud is removed. The clogged parts are then accessible through the shorter collector nozzle.

[0005] The configuration of known sliding gate valves has several shortcomings. Firstly, the removal and replacement operations of the ladle shroud are normally manual operations involving considerable safety risks to the operator. Secondly, the fixation of the ladle shroud to the collector nozzle is time consuming and a sealing contact between the ladle shroud and the collector nozzle has to be warranted. Thirdly, the collector nozzle being subject to significant wear, it constitutes a working part that has to be replaced frequently.

[0006] GB 2 271 734 discloses a sliding gate valve partially addressing the above problems by combining

the collector nozzle and the ladle shroud into a single lower nozzle. This sliding gate valve comprises a fixed plate with a through hole, a movable sliding plate with a through hole and a lower nozzle made of a refractory and secured stationary below the sliding plate. The lower nozzle has a length sufficient to cause a lower end portion thereof to be immersed into molten steel in a mold. This sliding gate valve however does not allow for easy and secure access to the vessel outlet or the flow channel and this lower nozzle is a hindrance when emptying slag or needs to be removed.

Object of the invention

[0007] The object of the present invention is to provide an improved sliding gate valve which overcomes the above problems.

General description of the invention

[0008] In order to achieve the object, the present invention proposes a sliding gate valve for a metallurgical vessel comprising a flow regulating means and a short length refractory outlet tube. According to an important aspect of the invention, the sliding gate valve further comprises an additional long length refractory flow protection tube and a mechanism for bringing, as required, either the outlet tube or the flow protection tube from a parking position into an operative position below the flow regulating means, respectively from the operative position into the parking position. The mechanism supports the short length refractory outlet tube and the long length refractory flow protection tube e.g. side by side. When positioned, the long length refractory flow protection tube basically assumes the function of a ladle shroud and the short length refractory outlet tube assumes the function of a collector nozzle. Instead of connecting, in a manner known per se, the flow protection tube in series to the outlet tube, the mechanism according to the invention allows to put either of them into an operative position as an extension of the outlet of the metallurgical vessel. The outlet tube is kept in a parking position and put into an operative position only if required. Accordingly, in operative position the flow protection tube simultaneously assumes the functions of a collector nozzle and a ladle shroud. The mechanism significantly increases the safety and the ease of use of sliding gate valves since no manual operations are necessary for bringing either of the tubes into an operative position.

[0009] The flow regulating means of the sliding gate valve normally has a fixed plate supporting a first refractory plate with a first orifice, a slide plate supporting a second refractory plate with a second orifice and a slide plate actuator for positioning the slide plate relative to the fixed plate in order to throttle a molten metal flow through an outlet of the vessel. In this case, the mechanism preferably provides sealing contact of the tube in the operative position with the second refractory plate. A

direct contact between the second lower refractory plate and the tube eliminates mechanical wear due to friction between these parts. With the mechanism providing the sealing contact, e.g. by urging means, no further measures are required to seal the operative tube against the lower refractory plate.

[0010] In a preferred embodiment, the mechanism comprises a mounting frame having a first holder for the outlet tube and a second holder for the flow protection tube, the mounting frame being moveably supported by the mechanism. This embodiment allows to simplify the mechanism since the tubes can be interchanged by simple displacement (e.g. translation) of the mounting frame.

[0011] Preferably, the mechanism comprises a linear actuator and guiding means for transforming a linear stroke of the actuator into a composite motion of the mounting frame, the composite motion comprising lowering, relocating and lifting the mounting frame. This allows for a compact construction and use of reliable linear actuators such as hydraulic cylinders.

[0012] The linear actuator and the guiding means are advantageously configured to provide a predetermined contact pressure for sealing contact of the tube in the operative position with a contact surface such as the first refractory plate.

[0013] In another preferred embodiment, the guiding means comprises a wedge means. Using the mechanically simple wedge principle allows to obtain a reliable and compact construction of the mechanism. Advantageously, the wedge means comprises a first wedge guide fixed to the mounting frame and a second wedge guide coupled to the linear actuator. The first wedge guide can be formed essentially by a plurality of ramp blocks disposed on a lower side of the mounting frame and the second wedge guide can be formed by a plurality of wedge rails cooperating with the ramp blocks. Each ramp block preferably comprises two oppositely directed ramps, each ramp being associated with one of two oppositely directed wedge rails. By a mirror inverted arrangement of the wedge means, the required length of the guiding means is reduced. Preferably, a wedge rail comprises an engagement means cooperating with a corresponding part on a ramp associated to the wedge rail so as to transmit horizontal movement for relocation of the mounting frame. Thereby the lowering, relocating and lifting can be obtained by a simple structure of wedges and ramps. Such a simple structure is reliable and requires little maintenance even in the adverse environmental conditions of metallurgical industry.

[0014] Advantageously, the mechanism further comprises a plurality of tilting members and corresponding tilt guides, the tilting members and tilt guides cooperating to block vertical movement of the mounting frame during relocation of the mounting frame, while allowing vertical movement of the mounting frame during lowering and lifting of the mounting frame. The tilting members can furthermore provide contact pressure contributing to sealing the slide plate against the fixed plate when either

one of the tubes is in the operative position. This additional contact pressure contributes to reduce the wear of the refractory plates since it allows to distribute the required forces more equally.

[0015] Accordingly, the invention also proposes an apparatus for use with a sliding gate valve for a metallurgical vessel. The apparatus comprises a first tube holder for supporting a first refractory tube and a second tube holder for supporting a second refractory tube. According to an important aspect the apparatus comprises a bi-directional positioning mechanism for bringing, as required, either the first or the second tube holder from a parking position into an operative position below the sliding gate valve, respectively from the operative position into the parking position. The apparatus furthermore comprises a mounting frame supporting the tube holders, the mounting frame being moveably supported by the positioning mechanism. The positioning mechanism comprises a linear actuator and guiding means for transforming a linear stroke of the actuator into a composite motion of the mounting frame, the composite motion comprising lowering, relocating and lifting the mounting frame. Such an apparatus can also be used to retrofit existing sliding gate valves in order to improve safety and ease of use thereof.

Detailed description with respect to the figures

[0016] The present invention will be more apparent from the following description of a not limiting preferred embodiment with reference to the attached drawings, wherein

- Fig. 1: is an exploded perspective view of a sliding gate valve according to a preferred embodiment;
- Fig. 2: is a lateral cross sectional view of the sliding gate valve of Fig. 1 in assembled state;
- Fig. 3: is a set of longitudinal cross sectional views according to planes AA', BB' and CC' of Fig. 2 showing an open condition of the sliding gate valve;
- Fig. 4: is a set of longitudinal cross sectional views according to planes AA', BB' and CC' of Fig. 2 showing a closed condition of the sliding gate valve and a configuration prior to tube exchange;
- Fig. 5: is a set of longitudinal cross sectional views according to planes AA', BB' and CC' of Fig. 2 showing a first configuration during tube exchange;
- Fig. 6: is a set of longitudinal cross sectional views according to planes AA', BB' and DD' of Fig. 2 showing a second configuration during tube exchange;
- Fig. 7: is a set of longitudinal cross sectional views according to planes AA', BB' and DD' of Fig. 2 showing a configuration after tube exchange.

[0017] Fig. 1 shows a sliding gate valve 10 in partially

disassembled state. The sliding gate valve 10 is normally mounted to an outlet orifice of a metallurgical vessel such as a tundish or teeming ladle (not shown). The sliding gate valve 10 comprises a flow regulating means 12 for throttling a molten metal flow out of the vessel. It furthermore comprises a mechanism 14 for supporting a short length refractory outlet tube 16 and a long length refractory flow protection tube 18.

[0018] As shown in Fig.1, the flow regulating means 12 comprises an upper fixed plate 20 with a first seat 22 for a first refractory plate 24. The first refractory plate 24 is normally made of a refractory material comprising alumina, zirconia, silica, magnesia or carbon or any suitable combination of these. In assembled state, a double hinged bar 26 attaches the fixed plate 20 on one side to a rigid frame 28. Clamps 30 secure the fixed plate 20 on the other side to the rigid frame 28. The double hinged bar 26 and the removable clamps 30 allow to flip open the sliding gate valve 10 for maintenance purposes. In operation, the fixed plate 20 and the rigid frame 28 remain stationary relative to the metallurgical vessel such that the orifice of the first refractory plate 24 coincides with the outlet of the vessel. The flow regulating means 12 also comprises a lower slide plate 32 with a second seat 34 for a second refractory plate 36. The second refractory plate 36 is made of the same or a similar refractory material used for the first refractory plate 24. The slide plate 32 is mounted to a housing 38 and has two lateral flanges 40.

[0019] In assembled state, the slide plate 32 is supported by the rigid frame 28 through the flanges 40. To this effect, two lateral pusher assemblies 42 are fixed to the periphery of the rigid frame 28. The pusher assemblies 42 are configured to urge the slide plate 32 against the fixed plate 20 in order to bring the first and second refractory plates 24, 36 into sealing contact. While maintaining sufficient contact pressure between the refractory plates 24, 36, the pusher assemblies 42 allow for a sliding movement of the slide plate 32 relative to the fixed plate 20. This sliding movement is obtained by a slide actuator 44. The slide actuator 44, preferably a hydraulic cylinder, is supported on the rigid frame 28 by means of a frame flange 45. Another frame flange 45' allows to mount the slide actuator 44 to the opposite side of the rigid frame 28 if required. The piston of the slide actuator 44 is coupled to a first coupling 46 on the housing 38. In a manner known per se, the position of the slide plate 32, i.e. the relative position of the orifices in the refractory plates 24 and 36, defines the throttling condition of the sliding gate valve 10.

[0020] As seen in Fig.1, the outlet tube 16 is executed as a short length refractory outlet tube and the flow protection tube 18 (only partially shown) as long length refractory flow protection tube. Accordingly, the outlet tube 16 can assume the function of a conventional collector nozzle when connected to the outlet of a metallurgical vessel while the flow protection tube 18 can assume the function of a conventional ladle shroud. In order to resist

the wear caused by molten metal, the tubes 16, 18 normally comprise an inward lining of a refractory material.

[0021] The mechanism 14 shown in Fig.1 comprises an essentially rectangular mounting frame 50. The mounting frame 50 has two distinct through holes and associated holders 52, 54 for receiving the outlet tube 16 and the flow protection tube 18 respectively. The holder 54 (for alleviation not shown) can be a conventional bayonet socket for removably holding the flow protection tube 18. The holder 52 can be of the same or a simpler type which allows replacement of the outlet tube 16 only during maintenance. In assembled state, the mounting frame 50 is moveably supported by the housing 38.

[0022] As will be detailed below, the mechanism 14 allows to bring either the outlet tube 16 or the flow protection tube 18 from a parking position into an operative position. The tube 16 or 18 which is in operative position constitutes an extension of the vessel outlet downstream the flow regulating means 12. Therefore the mounting frame 50 can describe a composite motion within the housing 38. This composite motion comprises lowering, relocating and lifting the mounting frame 50. The lowering allows to withdraw both tubes 16, 18, the relocating allows to position the other tube coaxially to the orifice of the refractory plate 36 and the lifting allows to put the tube 16 or 18 which is in operative position into sealing contact with the second refractory plate 36.

[0023] The threefold composite motion of the mounting frame 50 is obtained by a guiding means 60 which transforms the linear stroke of a linear actuator 56, preferably a hydraulic cylinder. The guiding means 60 is based on the principles of a wedge mechanism. The guiding means 60 comprises a first wedge guide 62 fixed to the lower side of the mounting frame 50 and a second wedge guide 64 moveably supported on a lower cover 66 of the housing 38. The second wedge guide 64 is coupled to the actuator 56 by means of a second coupling 68. The actuator 56 is supported on the housing 38 by a housing flange 57. Another housing flange 57' allows to mount the actuator 56 to the opposite side of the housing 38 if required.

[0024] As can be seen in Fig.1, the first wedge guide 62 comprises four ramp blocks 71. The ramp blocks 71 are fixed on the lower side of the mounting frame 50, two ramp blocks 71 being disposed on each longitudinal side. Each ramp block 71 comprises an outer ramp 72 and an inner ramp 72'. The inner and outer ramps 72', 72 have oppositely oriented inclined faces. The second wedge guide 64 comprises two outer wedge rails 74 and two inner wedge rails 74', with an inner and an outer wedge rail 74, 74' being grouped at either side of an access space 76 for the tubes 16, 18. The lower cover 66 as well as a lower lid 29 of the rigid frame 28 are provided with an oblong opening which allows the respective lower ends of the tubes 16, 18 to protrude below the sliding gate valve 10. The inner and outer wedge rails 74, 74' have a varying contour adapted for cooperation with the inclined faces of the ramp blocks 71. This cooperation

allows to transform the linear stroke of the actuator 56 into the composite motion of the mounting frame 50. It will be appreciated that the required constructional length of the second wedge guide 64 is significantly reduced by using horizontally flipped wedge rails 74, 74'. As further shown in Fig.1, two tilting members 80 are laterally and pivotably attached to each longitudinal edge of the mounting frame 50. Lower tilt guides 82 for guiding the tilting members 80 are arranged in the second wedge guide 64 between the outer and inner wedge rails 74, 74' respectively.

[0025] Fig.2 shows a lateral cross section of the sliding gate valve 10 of Fig.1 in assembled state. This cross section shows the flow protection tube 18 in operative position. The second refractory plate 36 of the slide plate 32 is urged against the first refractory plate 24 of the fixed plate 20 by means of the pusher assemblies 42 and in particular by means of Belleville disk springs 84 contained therein. The pusher assemblies 42 provide the pressure onto the flanges 40 which is required for sealing contact between the refractory plates 24, 36. As shown in Fig.2, the tilting members 80 provide pressure onto a support plate 86 for reinforcing this sealing contact and distributing the mechanical stress exerted onto the second refractory plate 36. It may be noted that the holder 52 for releasably securing the flow protection tube 18 to the mounting frame 50 is not shown in Fig.2 for alleviation. As seen in Fig.2, the arrangement of the parts of the mechanism 14 is generally symmetrical with respect to a central plane AA'. The arrangement insures a compact construction of the sliding gate valve 10. The contact surfaces between the housing 38 and the rigid frame 28 are defined by the first and second refractory plates 24, 36 and by the pusher assemblies 42. A minimum amount of friction is thereby warranted for the sliding movement of the slide plate 32. As best seen in Fig.2, the (long length refractory) flow protection tube 18 (only partially shown) and in particular its upper flange is in direct sealing contact with the second refractory plate 36. In this operative position, the flow protection tube 18 is connected directly to the flow regulating means 12 without an intermediate collector nozzle.

[0026] Figs.3 to 7 will now be used to describe the mechanism 14 in more detail. The mechanism 14 allows to bring as required, either the outlet tube 16 or the flow protection tube 18 from a parking position into an operative position below the flow regulating means 12 and vice-versa.

[0027] In Fig.3, the mechanism 14 is in a first end of travel configuration. In this configuration, the actuator 56 is fully extended whereby, as shown in section AA', the flow protection tube 18 is operative in axial extension of the orifice of the second refractory plate 36. The outlet tube 16 is in a parking position. The slide actuator 44 positioning the slide plate 32 is fully retracted, whereby the orifice in the second refractory plate 36 is coaxially positioned to a common central axis Z of the orifice in the first refractory plate 24 and the outlet of the metallur-

gical vessel (not shown). This pouring condition of the flow regulating means 12 allows maximum flow out of the vessel. As further shown in section AA', the mounting frame 50 maintains the short length refractory outlet tube 16 and the long length refractory flow protection tube 18 side by side below the flow regulating means 12.

[0028] As best seen in section BB' of Fig.3, the tilting members 80 have a symmetrical shape and comprise a first upper finger 90, a second upper finger 92 and a lower finger 94. Two tilting members 80 are pivotably mounted on a respective axis 96 to the mounting frame 50 on either longitudinal edge thereof. Section BB' of Fig.3 shows the tilting members 80 in a first tilted configuration corresponding to a first end of travel position of the mounting frame 50. In this configuration, the tilting members 80 are exerting an upward pushing force with the first upper finger 90 onto the support plate 86 and with their second upper finger 92 onto upper tilt guides 98. As can be seen in Fig.3, this force results from a torque on the axes 96 exerted by an upward force of the mounting frame 50 and/or a leftward force of the lower tilt guides 82 pushing the lower fingers 94.

[0029] Section CC' of Fig.3 shows the outer ramps 72 of the first wedge guide 62 and the outer wedge rail 74 of the second wedge guide 64. The outer ramps 72 are fixed to the lower side of the mounting frame 50. They abut with inclined faces 721 against corresponding wedge portions 741 of the wedge rail 74. As further seen in Section CC' of Fig.3, the mounting frame 50 abuts against a first horizontal limit stop 100 transversely fixed in the housing 38. It will be appreciated that extending action of actuator 56 combined with the inclined faces 721 and the wedge portions 741 allows to push the mounting frame 50 vertically upwards, once it has reached the horizontal limit stop 100. Thereby it is also possible exert an upwardly directed force onto the mounting frame 50, which in turn provides contact pressure for warranting a sealing contact of the flow protection tube 18 with the second refractory plate 36. The amount of force can be defined through the actuator 56.

[0030] Fig.4 shows the sliding gate valve 10 in a closed condition of the flow regulating means 12. As seen in section AA' of Fig.4, the slide actuator 44 is fully extended whereby the position of the slide plate 32 has been shifted to the left. In this condition, the second refractory plate 36 constitutes an obstruction to the flow of molten metal through the sliding gate valve 10. It also results from Fig. 4 that the actuator 44 has translated the housing 38 with the mechanism 14, the tubes 16, 18 and the actuator 56 together with the slide plate 32. When compared to three plate sliding gate valves, friction occurring during positioning of the slide plate 32 is reduced because the tubes 16, 18 are moved together with the slide plate 32. Nevertheless, with minor changes the mechanism 14 can be used with a three plate sliding gate valve (not shown).

[0031] As seen in sections BB' and CC' of Fig.4, except for the above translation, the mechanism 14 itself has kept the configuration of Fig.3. Molten metal flow being

inhibited, the closed valve condition of Fig.4 allows secure exchange of the flow protection tube 18 with the outlet tube 16, which is required e.g. for emptying slag, cleaning the flow channel of the vessel and/or the sliding gate valve during maintenance or in the occurrence of clogging of the vessel outlet. After this exchange, the short length refractory outlet tube 16 provides access to the flow channel e.g. for oxygen blowing.

[0032] Fig.5 shows a first intermediate configuration of the sliding gate valve 10 during the exchange of the flow protection tube 18 with the outlet tube 16. From section AA' it appears that the mechanism 14 has vertically withdrawn both tubes 16, 18 by lowering the mounting frame 50. This results from a first displacement 201 due to a retracting stroke of the piston of the actuator 56. As seen in section CC', the outer wedge rails 74 are drawn-off below the outer ramps 72 whereby the mounting frame 50 is moved vertically downwards according to arrow 210. As can be seen in section CC' of Fig.5, the second wedge guide 64 comprising the wedge rails 74, 74' and lower tilt guides 82 is moveable independently of the mounting frame 50 and the housing 38. The stroke of the actuator 56 (e.g. displacement 201) defines the position of the second wedge guide 64. As further seen in section CC' of Fig.5, driver edges 722 of the outer ramps 72 have engaged driver corners 742 of the outer wedge rails 74. This engagement allows to horizontally relocate the mounting frame 50 within the housing 38 according to arrow 212, in accordance with a further retracting stroke of the actuator 56. Section BB' of Fig. 5 shows the tilting members 80 in a second vertical configuration. In this configuration, the first and second upper fingers 90, 92 are allowed to slide along the lower edge of the upper tilt guides 98 in accordance with the horizontal relocation according to arrow 212. To this effect, the lower fingers 94 and part of the tilting members 80 are received by an opening in the lower tilt guides 82. In this configuration, the tilting members 80 provide blocking against vertical movement. This blocking allows to horizontally relocate the mounting frame 50 (along arrow 212 or oppositely) without undesired vertical motion.

[0033] Fig.6 shows a second intermediate configuration of the sliding gate valve 10 during the exchange of the flow protection tube 18 with the outlet tube 16. Compared to Fig.5, the actuator 56 has horizontally relocated the mounting frame 50 supporting the tubes 16, 18 through a second displacement 202. The mounting frame 50 abuts against a second horizontal limit stop 102. The outlet tube 16 is positioned coaxially to the orifice of the second refractory plate 36. As seen in section BB', only the first upper fingers 90 of the tilting members 80 are positioned below the upper tilt guides 98. Therefore, subsequent vertical upward motion of the mounting frame 50 according to arrow 214 is allowed. Section DD' of Fig. 6 shows the inner ramps 72' of the first wedge guide 62 and the inner wedge rail 74' of the second wedge guide 64. Compared to the outer ramps 72 and the outer wedge rails 74 in section CC' of Fig.5, the inner ramps 72' of the

first wedge guide 62 and the inner wedge rails 74' of the second wedge guide 64 are horizontally flipped, i.e. mirror inverted. This arrangement provides the relocation (as well as lifting and lowering) in the direction opposite to arrow 210. It may be noted that driver edges 722' and driver corners 742' provide engagement for horizontal relocation of the mounting frame 50 in this opposite direction upon an extension stroke of the actuator 56.

[0034] In Fig.7, the mechanism 14 is shown in a second end of travel configuration where the exchange of the flow protection tube 18 with the outlet tube 16 is achieved. In this configuration, the actuator 56 is fully retracted after a third displacement 203. As shown in section AA' of Fig. 7, the outlet tube 16 is operative in axial extension of the orifice of the second refractory plate 36. Section BB' of Fig.7 shows the tilting members 80 in a second tilted configuration corresponding to a second end of travel position of the mounting frame 50. In this configuration, the tilting members 80 are exerting an upwards pushing force with their first upper finger 90 onto the upper tilt guides 98 and with their second upper finger 92 onto the support plate 86. This force results from a torque on the axes 96 exerted by an upward force of the mounting frame 50 and/or a rightward force of the lower tilt guides 82 pushing the lower fingers 94.

[0035] As in Fig.6, section DD' of Fig.7 shows the inner ramps 72' of the first wedge guide 62 and the inner wedge rails 74' of the second wedge guide 64. Inclined faces 721' of the inner ramps 72' abut against corresponding wedge portions 741' of the inner wedge rails 74'. The inclined faces 721' and the wedge portions 741' allow to lift the mounting plate 50 from the intermediate position of Fig.6 into the end of travel position shown in Fig.7. In the configuration of Fig.7, retracting action of actuator 56 combined with the inner ramps 72' and inner wedge rails 74' allows to exert an upward force onto the mounting frame 50 according to arrow 214. This provides the required contact pressure for warranting a sealing contact of the outlet tube 16 with the second refractory plate 36.

[0036] In a subsequent step (not shown) the slide actuator 44 allows to bring the flow regulating means 12 of the sliding gate valve 10 into an open condition. This is achieved by translating the slide plate 32 together with the housing 38 and the mechanism 14 so as to obtain a condition similar to Fig.3 with however the outlet tube 16 being in operative position and the flow protection tube being 18 in a parking position.

[0037] As described above, the guiding means 60 transforms the linear stroke of the actuator 56 into a lowering, relocating and lifting composite motion of the mounting frame 50. It will be appreciated that the symmetrical arrangement of the inner and outer ramps 72, 72', wedge rails 74, 74' and tilting members 80 allows bi-directional positioning. The mechanism 14 provides motion in both directions i.e. according to arrows 210, 212, 214 as shown from Fig.4 to Fig.7 and vice-versa so as to return from the configuration of Fig.7 to the configuration of Fig.4. As a result, the mechanism 14 allows auto-

mated exchange of the tubes 16, 18 either into or out of the operative position. Although the exchange of the flow protection tube 18 with the outlet tube 16 is the preferred application, the mechanism 14 also simplifies the replacement of a worn flow protection tube 18.

[0038] In conclusion, a number of advantages resulting from the above description may be noted. As seen in Fig. 3 and Fig. 7, either one of the (short length refractory) outlet tube 16 or the (long length refractory) flow protection tube 18 can be automatically brought into an operative position as required. The mechanism 14 therefore significantly increases safety for human operators. Since the exchange of the tubes 16, 18 is automated, it is no longer required to manually remove or install the ladle shroud from or into serial connection to the collector nozzle. Wherever available space is limited, the manual procedure normally requires lifting and lowering of the vessel. This step is no longer required with the sliding gate valve 10. In addition, when compared to the serial connection of a ladle shroud to a collector nozzle, wear of the outlet tube 16 (corresponding to the collector nozzle) is significantly reduced. This results in significantly reduced consumption of instances of the latter as a wearing part. Furthermore, the mechanism 14 has a compact construction which allows integration into the structure of the sliding gate valve 10. Therefore, the sliding gate valve 10 provided with the mechanism 14 requires comparatively little constructional volume underneath a metallurgical vessel. The mechanism 14 being based on the wedge principle, the use of springs is avoided. Although their use is critical in high temperature environments as encountered in metallurgical processes, springs are commonly used to insure sealed contact of refractory tubes. Another known problem is the sealing of the connection between the collector nozzle and the ladle shroud. If not sufficiently sealed, this connection causes infiltration of air into the molten metal flow channel, whereby the quality of the final product is impaired. This problem is avoided by using a sliding gate valve provided with the mechanism 14.

Claims

1. A sliding gate valve for a metallurgical vessel, comprising:

a flow regulating means; and
 a short length refractory outlet tube;
characterized by
 an additional long length refractory flow protection tube; and
 a mechanism supporting said short length refractory outlet tube and said long length refractory flow protection tube for bringing, as required, either said outlet tube or said flow protection tube from a parking position into an operative position below said flow regulating

means, respectively from said operative position into said parking position.

2. A sliding gate valve according to claim 1, wherein said flow regulating means comprises a slide plate supporting a refractory plate and wherein said mechanism provides sealing contact of the tube in said operative position with said refractory plate.
3. A sliding gate valve according to claim 1 or 2, wherein said mechanism comprises a mounting frame having holders for said outlet tube and said flow protection tube, said mounting frame being moveably supported by said mechanism.
4. A sliding gate valve according to claim 3, wherein said mechanism comprises a linear actuator and guiding means for transforming a linear stroke of said actuator into a composite motion of said mounting frame, said composite motion comprising lowering, relocating and lifting said mounting frame.
5. A sliding gate valve according to claim 4, wherein said linear actuator and said guiding means are configured to provide a predetermined contact pressure for sealing contact of the tube in said operative position with a contact surface.
6. A sliding gate valve according to claim 4 or 5, wherein said guiding means comprises a wedge means.
7. A sliding gate valve according to claim 6, wherein said wedge means comprises a first wedge guide fixed to said mounting frame and a second wedge guide coupled to said linear actuator.
8. A sliding gate valve according to claim 7, wherein said first wedge guide comprises a plurality of ramp blocks disposed on a lower side of said mounting frame and wherein said second wedge guide comprises a plurality of wedge rails cooperating with said ramp blocks.
9. A sliding gate valve according to claim 8, wherein each ramp block comprises two oppositely directed ramps, each ramp being associated with one of two oppositely directed wedge rails.
10. A sliding gate valve according, to claim 9, wherein at least one of said wedge rails comprises an engagement means cooperating with a corresponding part on at least one ramp associated to said at least one wedge rail so as to transmit horizontal movement for relocation of said mounting frame.
11. A sliding gate valve according to any of claims 6 to 11, wherein said mechanism further comprises a plurality of tilting members and corresponding tilt

guides, said tilting members and tilt guides cooperating to block vertical movement of said mounting frame during relocation of said mounting frame, while allowing vertical movement of said mounting frame during lowering and lifting of said mounting frame. 5

12. A sliding gate valve according to claim 12, wherein said tilting members provide contact pressure contributing to sealing said slide plate when either one of said tubes is in said operative position. 10

13. An apparatus for use with a sliding gate valve for a metallurgical vessel comprising:

a first tube holder for supporting a first refractory tube and a second tube holder for supporting a second refractory tube; 15
a bi-directional positioning mechanism for bringing, as required, either said first or said second tube holder from a parking position into an operative position below said sliding gate valve, respectively from said operative position into said parking position; 20
a mounting frame supporting said tube holders, said mounting frame being moveably supported by said positioning mechanism; 25
said positioning mechanism comprising a linear actuator and guiding means for transforming a linear stroke of said actuator into a composite motion of said mounting frame, said composite motion comprising lowering, relocating and lifting said mounting frame. 30

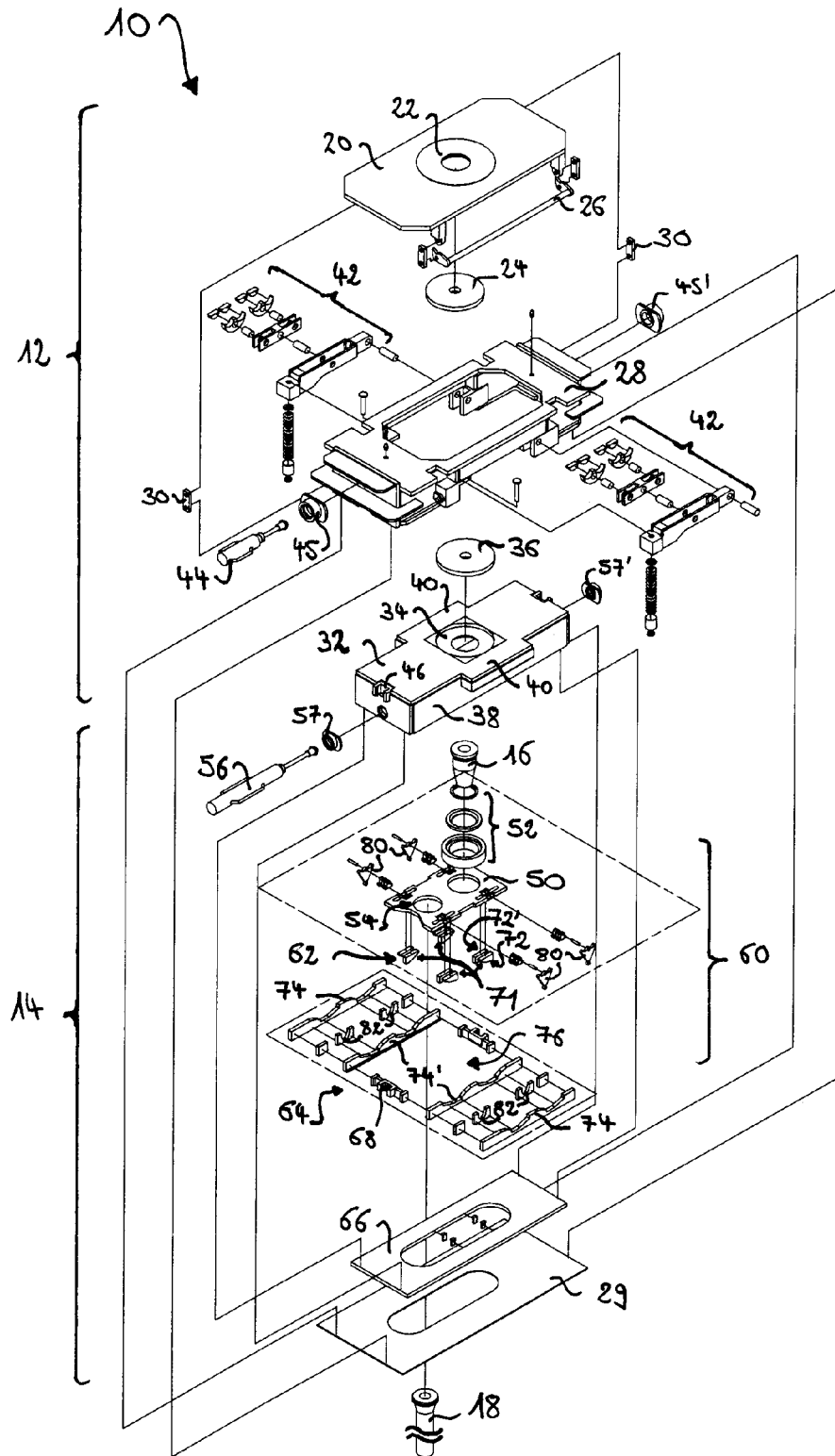
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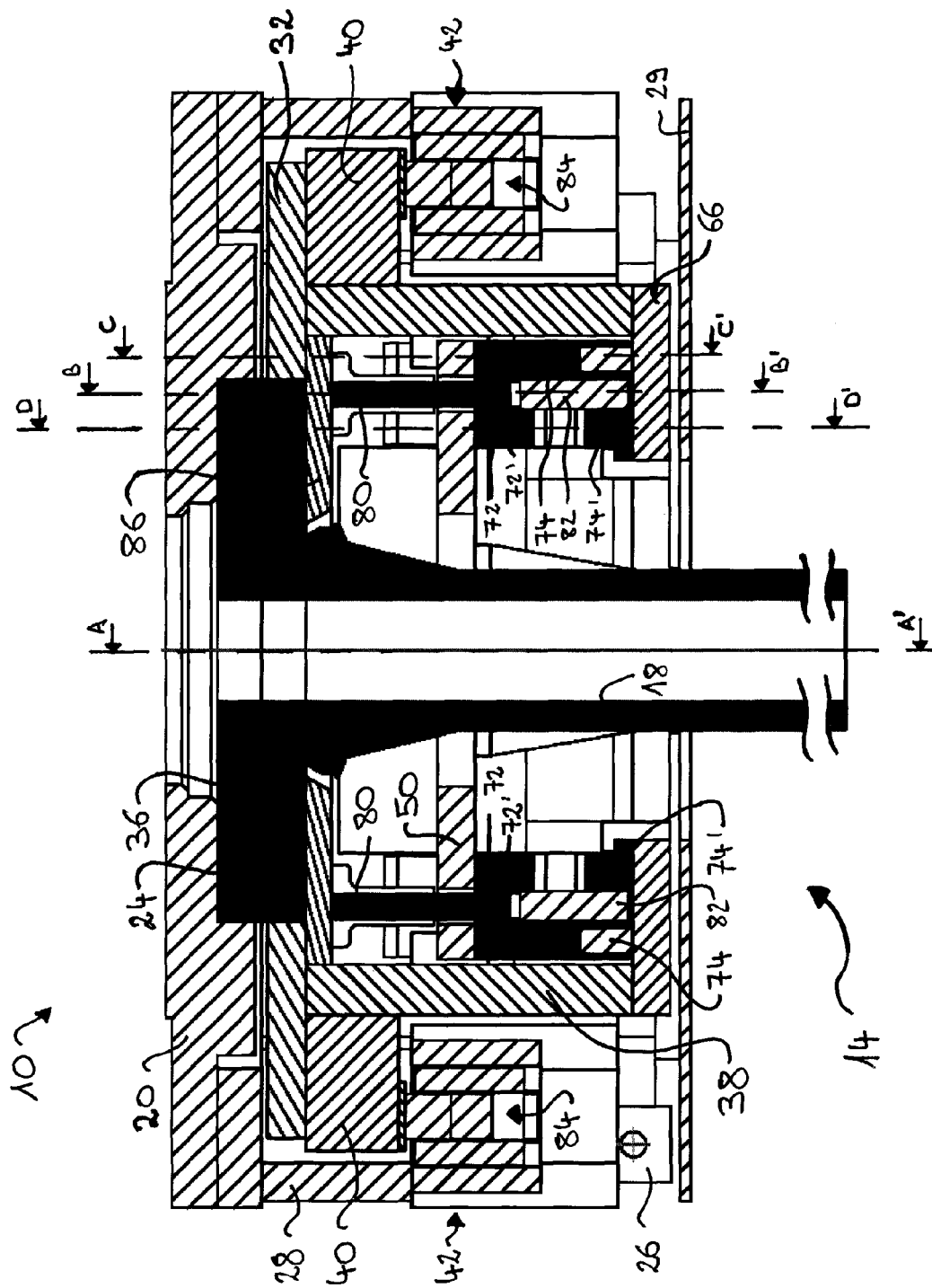
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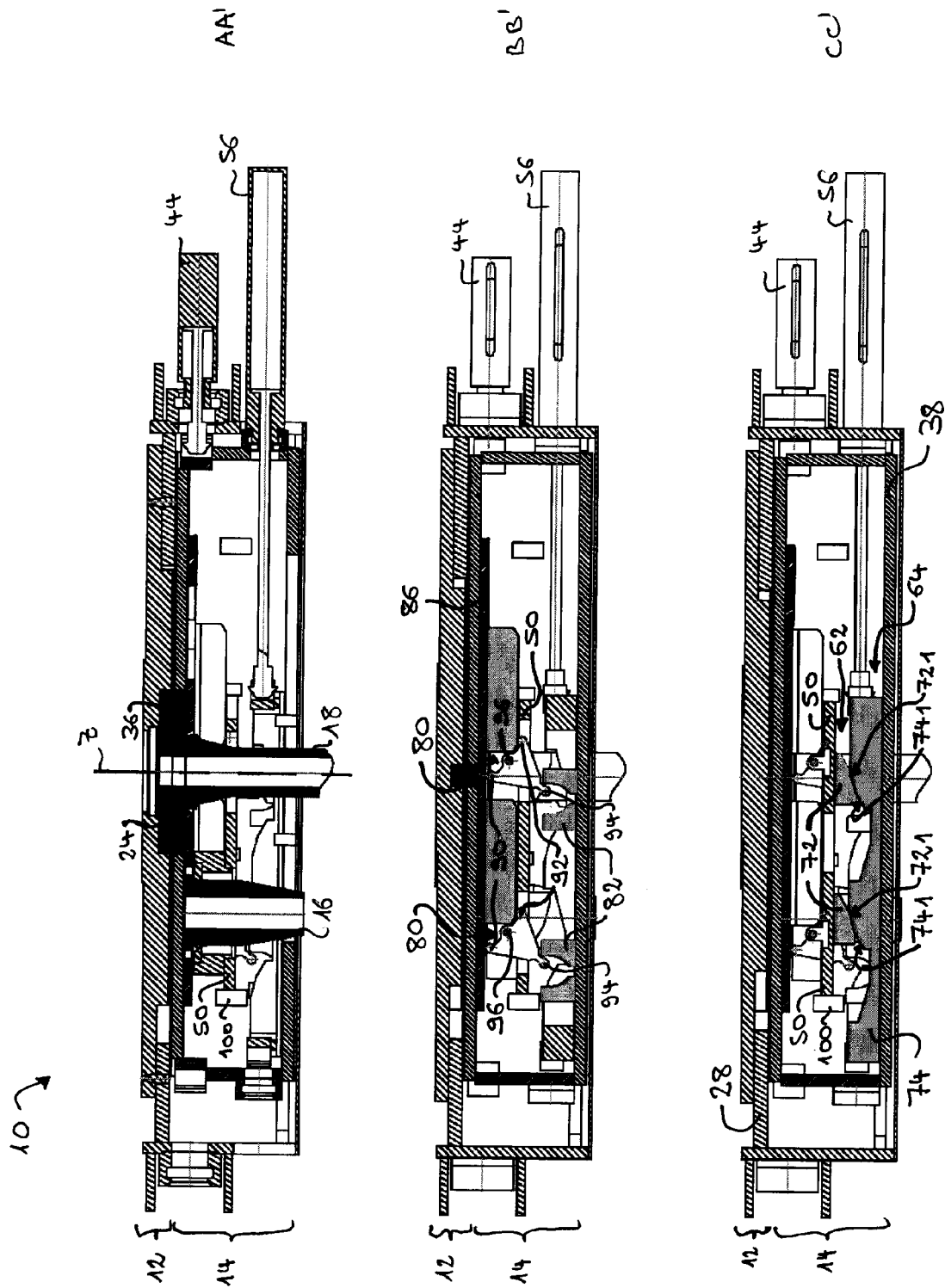
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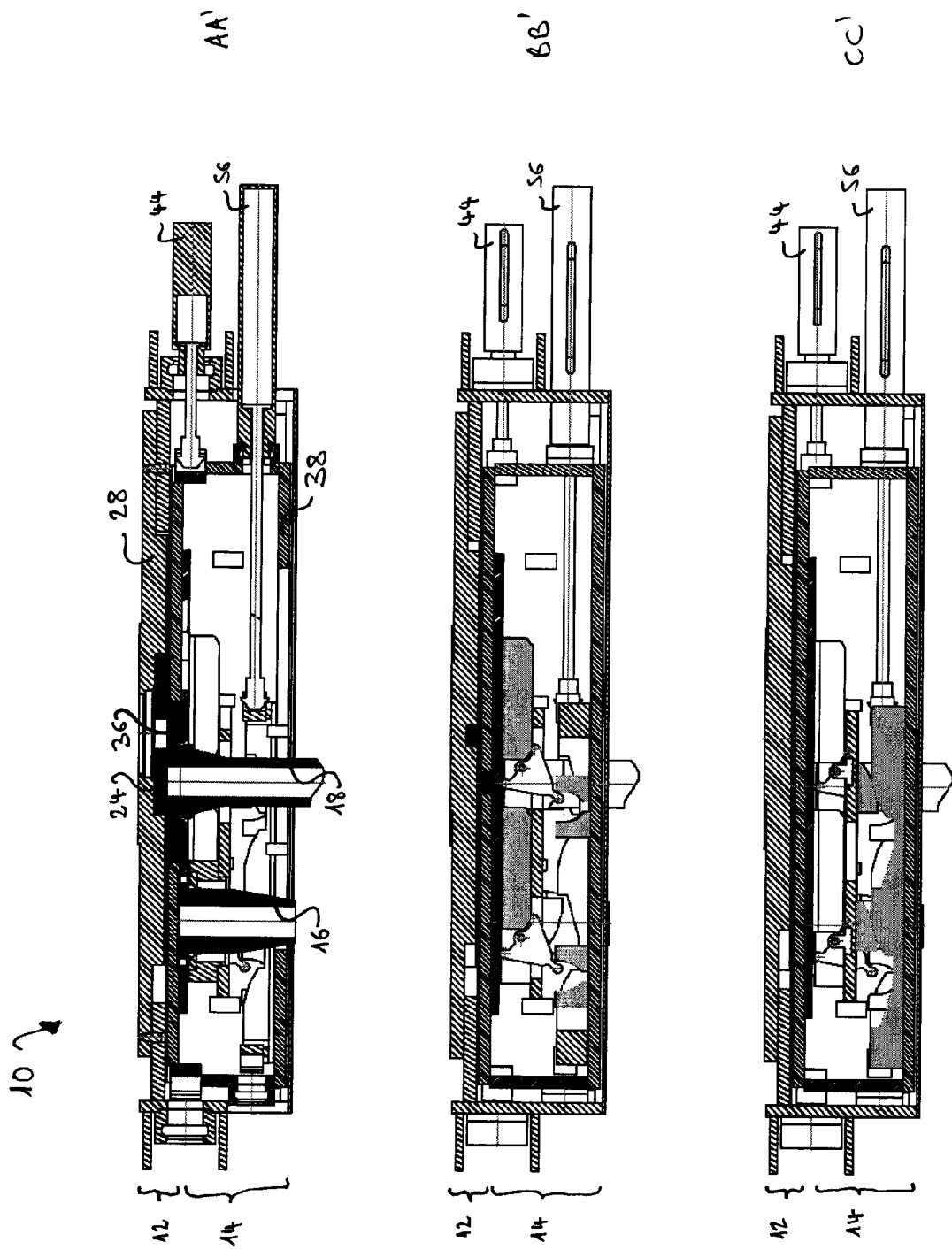
- Fig. 1 -



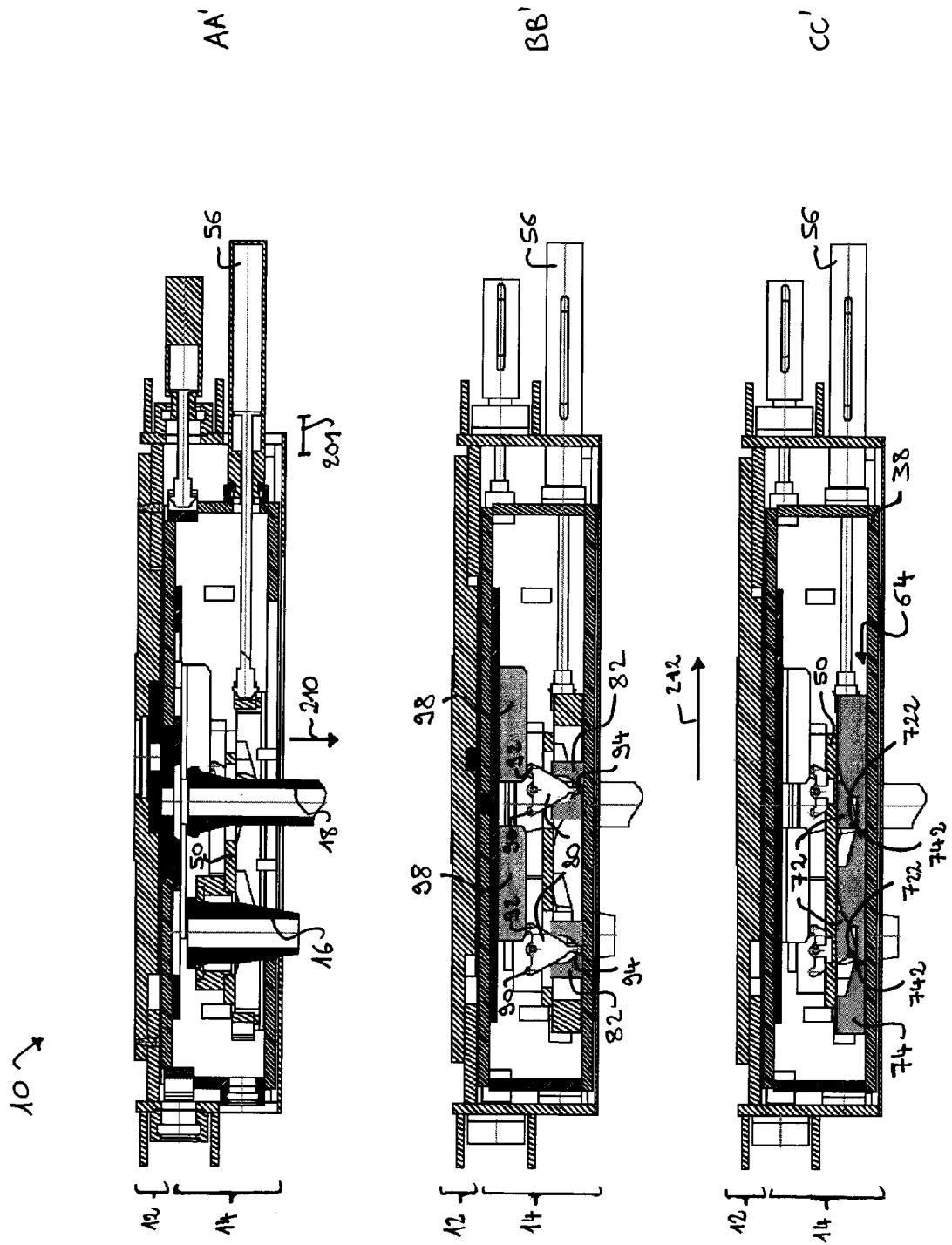
- Fig. 2 -



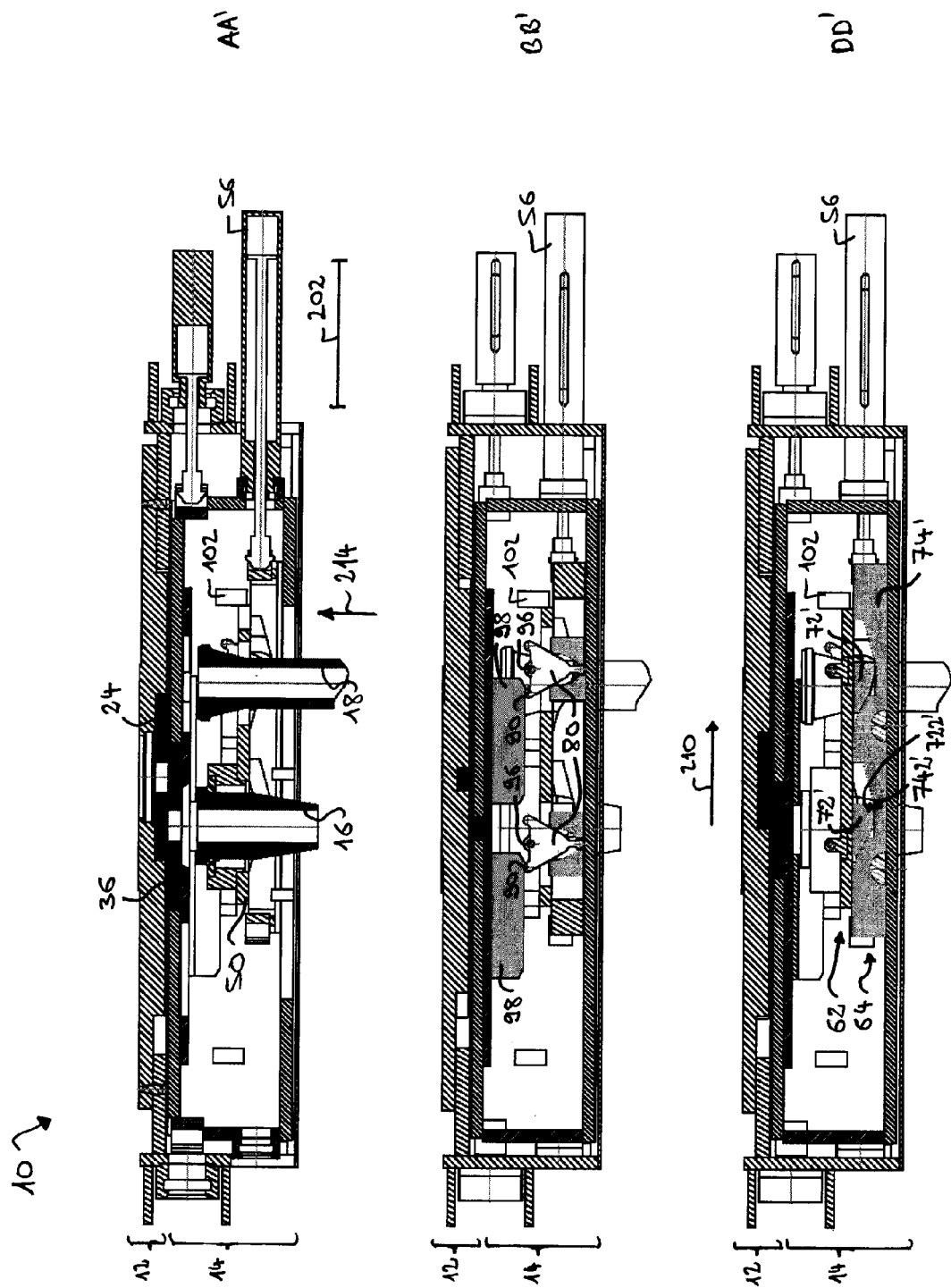
- Fig. 3 -



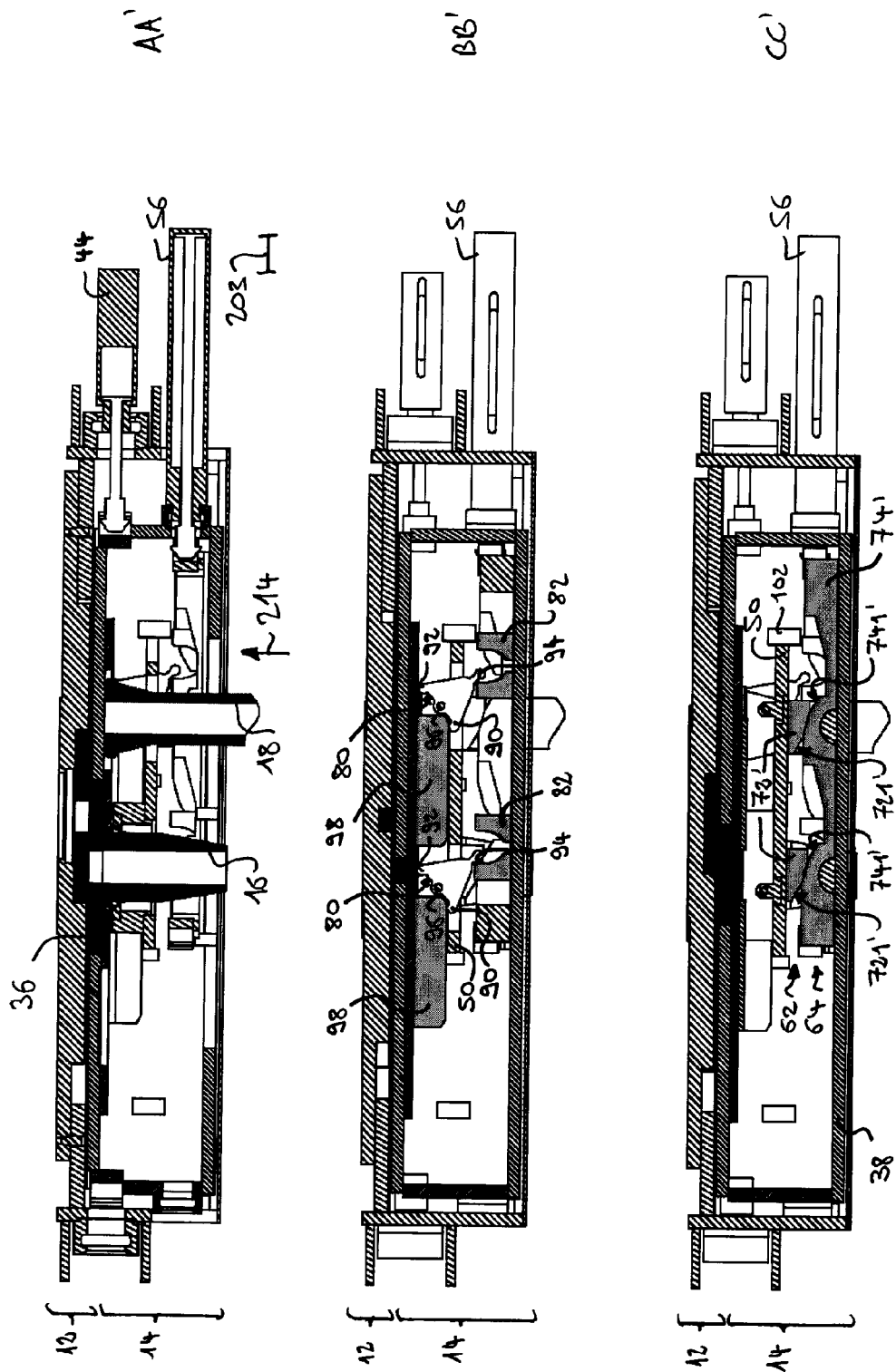
- Fig. 4 -



— Fig. 5 —



— Fig. 6 —



— Fig. 7 —



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EUROPEAN SEARCH REPORT

Application Number
EP 04 10 6738

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 August 2005	Examiner Hodiamont, S
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