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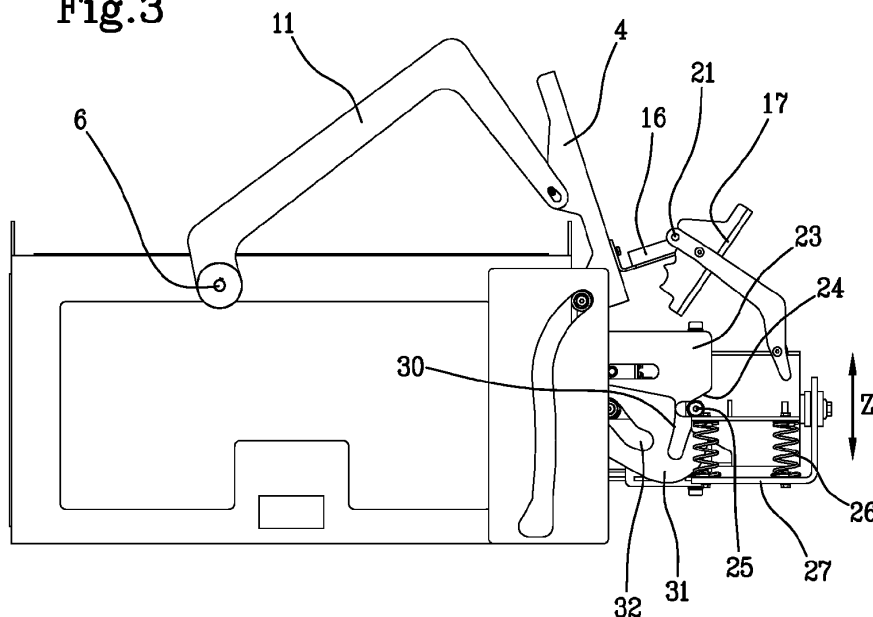
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(54) **A COUPLING SYSTEM FOR COUPLING A MOULD TO AN APPARATUS FOR SUPPLYING ENERGY**

(57) A coupling system is intended for coupling an apparatus for supplying energy (AE) and a mould (S) for producing concrete products, such that the apparatus for supplying energy (AE) can supply energy to at least one vibrator fitted to the mould (S). The coupling system (1) comprises a first coupling portion (2) having a connector (9) that is connectable to the apparatus for supplying energy (AE) and a second coupling portion (3) having a

further connector (10) that is connectable to the vibrator. An actuator (7) is provided for moving the connector (9) along an advancement direction (X) so as to cause the connector (9) to couple with the further connector (10). The coupling system (1) further comprises centring means (23, 24, 25, 35, 36, 37) for centring the further connector (10) with respect to the connector (9).

Fig.3



Description

[0001] The invention relates to a coupling system for coupling a mould, particularly a mould for producing concrete products, to an apparatus for supplying energy. The apparatus for supplying energy is intended for supplying energy to power a vibrator fitted on board the mould, so as to vibrate the concrete as soon as it is poured into the mould and facilitate the release of air from the concrete.

[0002] The apparatus for supplying energy can be configured to supply the vibrator with electrical energy, or alternatively pneumatic energy, depending on the type of vibrator used.

[0003] The coupling system according to the invention is particularly suitable for being used in a plant for producing prefabricated tunnel segments, beams or other structural elements intended for being used in the field of infrastructure for building tunnels or galleries for subways, railways, roads and the like. Alternatively, the coupling system according to the invention can be used in a plant for producing panels or other structural elements in civil construction.

[0004] Plants for producing concrete structural elements are known, comprising at least one movable mould, mounted on wheels, which is moved between several operating stations. During the production cycle, the mould is transported to a forming chamber, where it is filled with concrete and then vibrated to eliminate air from the concrete just poured into the mould.

[0005] To make the mould vibrate, it is necessary to connect a vibrator fitted to the mould with an apparatus for supplying energy arranged in a fixed position. To this end, a connector connected to the apparatus for supplying energy has to be coupled with a further connector provided on the mould. The connection between the two connectors currently occurs in a manual manner, owing to the intervention of an operator who must enter the forming chamber to connect the two connectors to each other before the vibration step begins and return to the forming chamber to disconnect one connector from the other when the vibration step has ended.

[0006] These manual interventions entail an inconvenience for the operator, who must move around in a noisy and sometimes dusty environment.

[0007] The risk of accidents for the operator is also increased, because the operator must leave a control cabin where he is normally found in order to go to the forming chamber to connect or disconnect the movable mould from the apparatus for supplying energy. Although many measures are taken to ensure the safety of the plant, it is not possible to completely exclude the risk of an accident for an operator walking inside the plant while the latter is operating.

[0008] An object of the invention is to improve the plants for producing concrete products, in particular for producing prefabricated elements intended for being used in the field of infrastructure or civil construction.

[0009] Another object is to reduce the manual inter-

ventions of operators in the plants for producing concrete products, increasing the degree of automation of such plants.

[0010] Another object is to increase the safety for the operators working in the plants for producing concrete products.

[0011] According to the invention, a coupling system is provided for coupling an apparatus for supplying energy and a mould for producing concrete products, such that the apparatus for supplying energy can supply energy to at least one vibrator fitted to the mould, the coupling system comprising a first coupling portion having a connector that is connectable to the apparatus for supplying energy and a second coupling portion having a further connector that is connectable to the vibrator, an actuator being provided for moving the connector along an advancement direction so as to cause the connector to couple with the further connector, and wherein the coupling system further comprises centring means for centring the further connector with respect to the connector.

[0012] Owing to the invention, the apparatus for supplying energy can automatically both be connected to the vibrator fitted to the mould and decoupled therefrom. It is therefore no longer necessary for the operator to come near the mould and manually make the connection between the connector and the further connector, nor to manually disconnect the further connector from the connector at the end of the vibration step. This allows to reduce the operator intervention and automates the plant for producing concrete products.

[0013] Furthermore, the risks of injury that the operator can face when exiting or entering the forming cabin to manually intervene on plant components are substantially eliminated.

[0014] The centring means allows the connector to be correctly engaged in the further connector even when such connectors are initially in a misaligned position, within certain limits. This further reduces the need for operator intervention, as the coupling system can correctly operate even if the two connectors are arranged in a position other than the expected theoretical position. This situation can easily occur in plants in which the movable mould moves between different operating stations, both because of the tolerances which are present between the plant components, and because of the wear phenomena that occur during the life of the plant.

[0015] In an embodiment, the centring means is configured for centring the further connector with respect to the connector transversely to the advancement direction.

[0016] In an embodiment, the centring means comprises first centring means for centring the further connector with respect to the connector in a first direction transversely to the advancement direction and second centring means for centring the further connector with respect to the connector in a second direction transversely to the advancement direction, the first direction being arranged transversely to the second direction.

[0017] This allows a precise positioning of the further

connector with respect to the connector.

[0018] The first centring means is distinct from the second centring means.

[0019] In an embodiment, the apparatus for supplying energy can be of the electrical type, in which case the connector and the further connector are electrical connectors for electrically powering the vibrator. The latter needs electricity to operate, i.e., it is an electric vibrator.

[0020] In an alternative embodiment, the apparatus for supplying energy is of the pneumatic type, i.e., it is configured for supplying the vibrator, through the connector and the further connector, with pneumatic energy in the form of compressed air. In this embodiment, the vibrator is a pneumatic vibrator, i.e., it needs compressed air for functioning.

[0021] In an embodiment, the coupling system comprises a locking element for locking the connector and the further connector in a coupling configuration. The locking device is distinct from the actuator.

[0022] The locking device reduces the risk of the connector and the further connector becoming prematurely detached from each other, even in the event of shock or vibration acting on the coupling system.

[0023] The invention can be better understood and implemented with reference to the accompanying drawings, which illustrate a non-limiting exemplary embodiment thereof, in which:

Figure 1 is a schematic side view showing a first coupling portion that is connectable to an apparatus for supplying energy and a second coupling portion associated with a mould, in a disengagement position;

Figure 2 is a side view like that of Figure 1, in a step in which a protection panel of the first coupling portion and a protection element of the second coupling portion are opening;

Figure 3 is a side view like that of Figure 1, in a step in which the second coupling portion begins to be centred with respect to the first coupling portion;

Figure 4 is a side view like that of Figure 1, showing the first coupling portion and the second coupling portion in a coupling position;

Figure 5 is a section taken along a vertical plane of Figure 3;

Figure 6 is a perspective view showing the second coupling portion;

Figure 7 is a perspective view showing the second coupling portion, taken from the opposite side with respect to Figure 6;

Figure 8 is a sectioned perspective view, taken on a vertical centreline plane, of the second coupling portion.

[0024] Figure 1 shows a coupling system 1 for coupling an apparatus for supplying energy to a movable mould in a plant for producing concrete products, in particular products made of reinforced concrete.

[0025] The movable mould, also called a formwork or form, is intended for producing a concrete product, for example a beam, a panel, a prefabricated segment or another structural element to be used in the construction of other structures, in the field of infrastructure or civil construction. By way of example, the structural element produced in the movable mould can have a curved geometry, so that it can be used to build tunnels, for example road tunnels, train tunnels or subway tunnels. That is, the structural element produced in the movable mould can be used in what is known as the field of "tunnelling".

[0026] The coupling system 1 is specifically intended for being used in a plant of the so called "carousel" type for producing structural concrete elements.

[0027] The "carousel" plants comprise one or more movable moulds, which can be moved along a closed path between a plurality of operating stations. Each movable mould comprises a support structure provided with a plurality of wheels, by means of which the movable mould is moved on rails along the closed path of the carousel plant.

[0028] The plurality of operating stations comprises a preparation station, in which the movable mould is prepared to receive the concrete to be hardened, by subjecting the mould to preliminary operations such as cleaning, application of lubricating oil, introduction of a wire mesh in the mould to obtain reinforced concrete, and the like.

[0029] A forming station is also provided, in which the concrete is poured into the movable mould, which is then vibrated to release air from the concrete which was poured into the mould.

[0030] Downstream of the forming station, a curing station is provided, in which the concrete is kept in the mould for a preset period of time, under controlled temperature and humidity conditions, to allow the concrete to harden optimally.

[0031] Finally, downstream from the curing station there is an unloading station, in which the product is removed from the mould and sent to a storage area.

[0032] In the forming station, a forming chamber is provided in which the movable mould containing the concrete is vibrated. The purpose of the forming chamber is to at least partially protect the construction site from the noise created by the vibrations. A vibrator is fitted to the support structure of the movable mould, the vibrator being operable for vibrating the mould. The vibrator can be of the electric type, in which case it needs to be powered with electrical energy, or of the pneumatic type, in which case it needs to be powered with pneumatic energy, i.e., compressed air.

[0033] The plant for producing concrete products comprises an apparatus for supplying energy, suitable for delivering the energy required for operating the vibrator. The apparatus for supplying energy can be positioned inside the forming chamber, or outside the latter.

[0034] For example, if the vibrator must be powered with pneumatic energy, the apparatus for supplying en-

ergy can be a compressor intended to deliver compressed air. If the vibrator must be powered with electrical energy, the apparatus for supplying power can be a control panel connected to the mains grid.

[0035] The coupling system 1 is intended for connecting the apparatus for supplying energy to the movable mould, so that the apparatus for supplying energy supplies the vibrator with the energy required for its operation, and the vibrator consequently vibrates the mould to release the air from the concrete.

[0036] The coupling system 1 comprises a first coupling portion 2 and a second coupling portion 3. The first coupling portion 2 is connectable to the apparatus for supplying energy, for example by means of a connecting cable 34 schematically shown in Figure 1. The apparatus for supplying energy is schematically shown in Figure 1 and indicated with AE.

[0037] The second coupling portion 3 is fitted to the movable mould and can be shaped as a box protruding from one side of the movable mould. The movable mould is also schematically shown in Figure 1 and is indicated with S.

[0038] The first coupling portion 2 and the second coupling portion 3 are movable between a disengagement configuration P1, shown in Figure 1, and a coupling configuration P2, shown in Figure 4. In the disengagement configuration P1, the first coupling portion 2 and the second coupling portion 3 are spaced from each other and the movable mould is not connected to the apparatus for supplying energy. In the coupling configuration P2, the first coupling portion 2 is coupled with the second coupling portion 3 and the apparatus for supplying energy supplies energy to the movable mould for operating the vibrator.

[0039] More specifically, in the coupling configuration P2, a connector 9, visible in Figure 5, included in the first coupling portion 2, is connected to a further connector 10 included in the second coupling portion 3, so that the electrical or pneumatic energy can be transmitted from the apparatus for supplying energy to the movable mould.

[0040] The first coupling portion 2 comprises a casing 5 within which the connector 9 is housed, together with some components for coupling the connector to the further connector fitted to the mould.

[0041] As shown in Figure 5, the first coupling portion 2 comprises an actuator 7 for moving the connector 9 along an advancement direction X between the disengagement configuration P1 and the coupling configuration P2. The actuator 7 can be a hydraulic cylinder, a pneumatic cylinder, an electric actuator or other. The actuator 7 is housed in the casing 5. The actuator 7 has a cylinder inside of which a stem is provided, the stem being displaceable back and forth along the advancement direction X, which in the example shown is horizontal. A carriage 8 which supports the connector 9 is fixed to the stem of the actuator 7.

[0042] When the actuator moves the stem forwards, i.e., causes the stem to slide towards the second coupling

portion 3 in the advancement direction X, the connector 9 passes from an internal position, in which the connector 9 was housed inside the casing 5, to an external position, in which the connector 9 protrudes from the casing 5 for engaging with the further connector 10. The connector 9 passes from the internal position to the external position owing to the movement of the actuator 7, without the need for the operator to manually couple the connector 9 to the further connector 10. For coupling the two connectors and initiating the vibration step, it is sufficient for the operator, in a remote position (i.e., outside the forming chamber) to give a command for driving the actuator 7, for example by pressing a button. This operation could also be automated.

[0043] The first coupling portion 2 comprises a protection panel 4 for protecting the connector 9 intended for being connected to the second coupling portion 3. The protection panel 4 further allows to protect the actuator 7 and the electrical and electronic components present inside the casing 5. In the disengagement configuration P1, the protection panel 4 is located in a closed configuration, shown in Figure 1, so as to isolate the connector 9 included in the first coupling portion 2 and the other components arranged inside the casing 5 from the external environment. Thereby, it is possible to prevent dust or other contaminants from entering the first coupling portion 2 and soiling the connector 9. In the coupling configuration P2, shown in Figure 4, the protection panel 4 is located in an open configuration to allow the connector 9 to exit from the casing 5 and couple with the further connector 10 provided in the second coupling portion 3.

[0044] The protection panel 4 has a plate-like geometry and is arranged for selectively closing or opening an opening provided on a face of the casing 5 facing the second coupling portion 3.

[0045] The protection panel 4 and/or the face of the casing 5 on which the protection panel 4 is fitted can be provided with one or more gaskets for ensuring seal against dust when the protection panel 4 is arranged in the closed configuration.

[0046] The protection panel 4 is supported in a tilting manner by a linkage 11. The linkage 11 is fixed to a pin 6, which is fitted to the casing 5 in such a way as to be rotatable with respect to the casing 5.

[0047] A cam device not depicted is housed in the casing 5. The cam device is configured to rotate the pin 6 when the actuator 7 moves the connector 9 from the internal to the external position. More specifically, the cam device can be fitted on board the carriage 8. When the carriage 8 is pushed by the actuator 7 in the advancement direction X towards the outside of the casing 5, the cam device rotates the pin 6. Consequently, the linkage 11 rotates with respect to the casing 5 and the protection panel 4 moves from the closed configuration to the open configuration.

[0048] Thereby, the protection panel 4 is automatically displaceable from the closed configuration to the open configuration when the actuator 7 is operated for bringing

the connector 9 into engagement with the further connector 10.

[0049] Two side appendages 13 are fixed to the casing 5, the side appendages 13 being arranged on opposite sides of the casing 5. Each side appendage 13 is provided with a guide slot 14. Two wheels 15 are fixed to the protection panel 4, each of which engages in a guide slot 14. As the protection panel 4 passes from the closed configuration to the open configuration, the wheels 15 move into the corresponding guide slot 14. More specifically, each wheel 15 is located in a lower portion of the corresponding guide slot 14, when the protection panel 4 is arranged in the closed configuration. The wheels 15 move upwards as the protection panel 4 passes from the closed configuration to the open configuration, until reaching an upper portion of the corresponding guide slot 14. This allows to keep the protection panel 4 guided while such a panel is moved from the closed configuration to the open configuration or vice versa.

[0050] The second coupling portion 3 comprises a box-like body 18, better visible in Figures 6 to 8, inside which the further connector 10 is housed.

[0051] The second coupling portion 3 has a protection element 17, arranged for isolating the further connector 10 from the external environment when the further connector 10 is not coupled with the connector 9, so as to prevent the further connector 10 from being contaminated with dust, steam or other dirt particles.

[0052] To this end, the protection element 17 and/or the portion of the box-like body 18 in which the protection element 17 engages can be provided with one or more gaskets.

[0053] The protection element 17 can have a substantially plate-like shape.

[0054] The protection element 17 is displaceable from a closed position, shown in Figure 1, and an open position, shown in Figure 4. In the closed position, the protection element 17 prevents access to the further connector 10. In the open position, the protection element 17 opens a front part of the box-like body 18 to allow the connector 9 to be connected to the further connector 10.

[0055] More specifically, as shown in Figures 6 and 7, the second coupling portion 3 comprises a lever system 20, hinged to the box-like body 18 at a fulcrum 19. At an end opposite the end hinged to the box-like body 18, the lever system 20 is tiltingly connected to the protection element 17.

[0056] The protection element 17 is displaceable from the closed position to the open position, and vice versa, owing to a rotation movement of the lever system 20 around the fulcrum 19, and owing to an oscillating movement of the protection element 17 around the lever system 20.

[0057] A drive member 16, visible in Figure 1, is provided on the protection panel 4 of the first coupling portion 2 for moving the protection element 17 between the open position and the closed position.

[0058] The drive member 16 can be shaped like a pro-

tuberance projecting from the protection panel 4 towards the second coupling portion 3.

[0059] The protection element 17 is further provided, in a zone thereof facing the first coupling portion 2, with an engagement member 21 with which the drive member 16 can engage for moving the protection element 17 from the closed position to the open position. The engagement member 21 can be shaped like a rod, for example having a substantially circular cross section, extending perpendicular to the advancement direction X, i.e., horizontally. The drive member 16, which, as mentioned above, is shaped like a protuberance projecting towards the protection element 17, is designed for engaging below the engagement member 21 so as to push the engagement member 21 upwards and consequently lift the protection element 17 for bringing it into the open position. This occurs when the actuator 7 pushes the carriage 8 towards the second coupling portion 3, thereby causing the carriage 8 to exit from the casing 5, and consequently moves the protection panel 4 upwards, for bringing it into the open configuration.

[0060] The protection panel 4 and the protection element 17 define a protection structure suitable for protecting the connector 9 and the further connector 10 from dirt, dust, steam and other contaminants, when the mould is not connected to the apparatus for supplying energy.

[0061] When the connector 9 is disconnected from the further connector 10, the protection structure is arranged in a protection configuration, i.e., it closes the casing 5 and the box-like body 18, thereby isolating the connector 9 and the further connector 10 from the external environment. The protection structure is brought into an accessibility configuration, i.e., it ceases to exert its protection function, when the protection panel 4 is brought into the open configuration and when the protection element 17 is brought into the open position. This occurs automatically, when the actuator 7 is operated for moving the connector 9 into the external position, i.e., when the carriage 8 is moved towards the outside of the casing 5.

[0062] The coupling system 1 comprises centring means which is active when the connector 9 and the further connector 10 are brought closer to each other, for positioning the second coupling portion 3, and thus the further connector 10, in a centred position with respect to the first coupling portion 2, and thus with respect to the connector 9. Thus, the centring means allows the connector 9 to be correctly coupled with the further connector 10.

[0063] The centring means comprises first centring means for centring the further connector 10 with respect to the connector 9 in a first direction arranged perpendicularly to the advancement direction X, i.e., in a direction Z, which in the example depicted is a vertical direction.

[0064] The centring means further comprises second centring means for centring the further connector 10 with respect to the connector 9 in a second direction arranged transversely, in particular perpendicularly to the ad-

vancement direction X, i.e., in a direction Y, which in the example depicted is horizontal. The first centring means can comprise a pair of guiding walls 23, which delimit the carriage 8 from two opposite sides. One of the guiding walls 23 is shown in particular in Figures 2 and 3. Each guiding wall 23 has a centring recess 24, which extends mainly along a direction parallel to the advancement direction X.

[0065] Each centring recess 24 has an open end facing the second coupling portion 3. The width of each centring recess 24, measured in the vertical direction Z, decreases progressively towards the inside of the casing 5. The centring recesses 24 can be "V"-shaped, with the axis of the "V" arranged horizontally and the bottom of the "V" rounded.

[0066] Each centring recess 24 is configured for receiving a protruding element projecting from the box-like body 18. The protruding element can be shaped like a shank 25 fitted to the box-like body 18. Each shank 25 can comprise a roller rotating idly around an axis thereof. The axes of the shanks 25 can be arranged horizontally, in particular along the direction Y. Each shank 25 protrudes laterally from the box-like body 18.

[0067] The second centring means can comprise a pair of further guiding walls 35, shown in Figure 5, which delimit the carriage 8 downwards and upwards, respectively. Each further guiding wall 35 can be arranged in a substantially horizontal plane.

[0068] Each further guiding wall 35 has a further centring recess 36, which extends mainly along a direction parallel to the advancement direction X.

[0069] The further centring recesses 36 each have an open end facing the second coupling portion 3. The width of each further centring recess 36, in the direction Y, progressively decreases towards the inside of the casing 5. The further centring recesses 36 can be "V"-shaped, with the axis of the "V" arranged horizontally and the bottom of the "V" rounded.

[0070] Each further centring recess 36 is configured for receiving a further protruding element protruding from the box-like body 18. The further protruding element can comprise a further shank 37 fitted to the box-like body 18. Each further shank 37 can comprise a roller rotating idly around an axis thereof. The axes of the further shanks 37 can be arranged vertically, i.e., they can each extend along the direction Z.

[0071] The further shanks 37 protrude upwards and downwards, respectively, from the box-like body 18.

[0072] When the actuator 7 pushes the carriage 8 towards the second coupling portion 3, the shanks 25 are received in the centring recesses 24 and the further shanks 37 are received in the further centring recesses 36. Due to the shape of the centring recesses 24 and the further centring recesses 36, initially there is a high clearance between each shank 25 and the corresponding centring recess 24 and respectively between each further shank 37 and the corresponding further centring recess 36. This clearance is reduced as the carriage 8 approach-

es the second coupling portion 3, which allows the further connector 10 to be positioned in a centred position with respect to the carriage 8, so that the connector 9 can smoothly couple with the further connector 10.

[0073] In more detail, the shanks 25 engaging in the centring recesses 24 have a centring action in the direction Z, while the further shanks 37 engaging in the further centring recesses 36 have a centring action in the direction Y. The box-like body 18 is supported by the mould with the interposition of a plurality of elastic elements 26. In the example depicted, the elastic elements 26 are shaped like coil springs interposed between the box-like body 18 and a support bracket 27, by means of which the box-like body 18 is fixed to the mould.

[0074] An adapting means is interposed between the box-like body 18 and the support bracket 27 for adjusting the position of the box-like body 18, and thus of the further connector 10, with respect to the mould, depending on the relative position between the first coupling portion 2 and the second coupling portion 3.

[0075] The adapting means allows, in particular, to adapt the position of the further connector 10 along the direction in which the actuator 7 moves the connector 9, i.e., along the advancement direction X.

[0076] As shown in Figure 8, the box-like body 18 is fixed to the support bracket 27 owing to a fixing element 38, which in the example depicted is a threaded fixing element, comprising for example a screw. The fixing element 38 passes through a hole 28 obtained in the support bracket 27 and engages with a further fixing element 39, for example a threaded element such as a threaded nut, arranged within the box-like body 18.

[0077] The internal transverse dimension, for example the internal diameter, of the hole 28 is greater than the external transverse dimension, for example the external diameter, of the fixing element 38, so that there is a predetermined clearance between the hole 28 and the fixing element 38.

[0078] The fixing element 38 extends in the advancement direction X, i.e., in the direction in which connector 9 is advanced for coupling it with the further connector 10.

[0079] A vibration-damping element 29 is interposed between the support bracket 27 and the box-like body 18. The vibration-damping element can be substantially cylindrical in shape and can be made of an elastomeric or polymeric material. The vibration-damping element 29 has a central hole inside which the fixing element 38 passes. The vibration-damping element 29 is compressible, within certain limits, in the advancement direction X. The vibration-damping element 29 acts as a shock absorber both in making softer the coupling between the connector 9 and the further connector 10, and in damping the vibrations generated when the vibrator vibrates the mould within which the concrete has been placed.

[0080] Furthermore, the vibration-damping element 29 acts as a stroke end when the connector 9 is coupled to the further connector 10. Owing to its compressibility along the advancement direction X, the vibration-damp-

ing element 29 allows to vary, within certain limits, the relative position of the box-like body 18 and the mould, so as to precisely position the further connector 10 with respect to the connector 9 even if the further connector 10 is initially located in a different position from the expected one, for example due to the wear of the mould wheels and/or the rails on which the mould is moved.

[0081] The elastic elements 26 and the clearance between the hole 28 and the fixing element 38 make it possible to centre the further connector 10 with respect to the connector 9, because they allow a certain freedom of movement of the box-like body 18 with respect to the support bracket 27, which makes it possible to adapt the position of the further connector 10 to the position of the connector 9.

[0082] The coupling system 1 further comprises two locking elements 31, one of which can be seen in Figures 3 and 4, for locking the first coupling portion 2 and the second coupling portion 3 with respect to each other in the coupling configuration P2, so that the connector 9 and the further connector 10 remain engaged with each other for as long as it is necessary to supply energy to the vibrator

[0083] The locking elements 31 are fitted to the carriage 8 so that they can rotate, as will be better described below.

[0084] Each locking element 31 can be shaped like a plate capable of oscillating in a vertical plane. The position of each locking element 31 is controlled by a cam mechanism, which in the example depicted comprises a cam track 32 provided on each locking element 31. The cam track 32 can be shaped like a slot passing through the thickness of the locking element 31. A control element 33 is movable inside each cam track 32. The control elements 33, which can comprise respective idle rollers, are fitted to opposite walls of the carriage 8 so that they each engage with a cam track 32 of the locking element 31.

[0085] Each locking element 31 further comprises a hooking opening 30 configured for engaging with an element fitted to the box-like body 18, which in the example depicted is the shank 25.

[0086] When the actuator 7 pushes the carriage 8 outside the casing 5, the control elements 33 move inside the respective cam tracks 32. Due to the shape of the cam tracks 32, the locking elements 31 are rotated upwards, so that each hooking opening 31 engages with the corresponding shank 25, thereby receiving the shank 25 inside the corresponding hooking opening 31. Owing to the coupling between each shank 25 and the corresponding hooking opening 31, the box-like body 18 is locked with respect to the first coupling portion 2, in the coupling configuration P2. It is thereby possible to ensure that the connector 9 remains coupled with the further connector 10 even in the presence of vibrations of the mould.

[0087] When each hooking opening 31 is engaged with the corresponding shank 25, the connector 9 remains

coupled with the further connector 10 even if the pressurised fluid supply to the actuator 7 is interrupted. This safeguards the actuator 7 if the latter is a hydraulic actuator.

[0088] During operation, the movable mould is brought into the forming chamber, for example by moving the movable mould on rails, and is positioned near the first coupling portion 2 so that the first coupling portion 2 and the second coupling portion 3 face each other in the disengagement configuration P1, as shown in Figure 1.

[0089] The connector 9 is initially in the internal position, i.e., it is housed inside the casing 5, and is isolated from the external environment owing to the protection panel 4, which is located in the closed configuration. The protection element 17 of the second coupling portion 3 is also in the closed position to prevent access to the further connector 10 and its contamination with dust, steam or dirt.

[0090] In order to couple the connector 9 to the further connector 10, the actuator 7 is activated so as to move the carriage 8 in the advancement direction X towards the second connecting portion 3. As the carriage 8 advances towards the second connecting portion 3, the cam device housed in the casing 5 rotates the pin 6, thus driving the linkage 11. More specifically, the linkage 11 is rotated anti-clockwise in the example depicted, i.e., upwards. Thus, the protection panel 4 is moved from the closed configuration to the open configuration.

[0091] As the protection panel 4 is lifted, the drive member 16 is positioned below the engagement member 21 and in contact with the latter, so as to lift the protection element 17, as shown in Figure 2. The protection element 17 is thus brought towards the open position, owing to the rotation of the lever system 20 around the fulcrum 19 and owing to the oscillation of the protection element 17 with respect to the lever system 20.

[0092] Meanwhile, as the carriage 8 is moved towards the second coupling portion 3, the guiding walls 23 and the further guiding walls 35, which are part of the carriage 8, begin to exit from the casing 5, as shown in Figure 2.

[0093] The actuator 7 continues to push the carriage 8 towards the second coupling portion 3. The linkage 11, controlled by the corresponding cam device, continues to rotate upwards, until the protection element 4 reaches the open configuration. Owing to the drive member 16 acting on the engagement member 21, the protection element 4 also brings the protection element 17 into the open position, as shown in Figure 3.

[0094] The guiding walls 23 and the further guiding walls 35 approach the box-like body 18. At a certain point, as shown in Figure 3, the shanks 25 enter the centring recesses 24 and the further shanks 37 enter the further centring recesses 36.

[0095] As the carriage 8 continues to be pushed towards the second coupling portion 3, the shanks 25 and the further shanks 37 enter deeper and deeper into the corresponding centring recesses 24 and further centring recesses 36. Since the dimension, in the direction Z, of

the centring recesses 24 decreases towards the inside of the casing 5, as the shanks 25 penetrate in the centring recesses 24, the box-like body 18 supporting the shanks 25 is positioned at a desired height along the direction Z. Similarly, since the dimension, in the direction Y, of the further centring recesses 36 decreases towards the inside of the casing 5, as the further shanks 37 penetrate in the further centring recesses 36, the box-like body 18 supporting the further shanks 37 is positioned in a desired position along the direction Y.

[0096] Thus, the further connector 10 is centred with respect to the connector 9, both along the direction Y and along the direction Z. Therefore, the coupling between the connector 9 and the further connector 10 is made possible. The elastic elements 26 and the clearance between the hole 28 and the fixing element 38 allow a certain freedom in positioning the box-like body 18 with respect to the support bracket 27, so that the position of the box-like body 18 can be adapted to the position of the connector 9, without further moving the movable mould.

[0097] As the carriage 8 is advanced in the advancement direction X, the control elements 33, engaged in the cam tracks 32, rotate the locking elements 31 upwards. The guide openings 30 thus hook the shanks 25, locking the casing 5 and the box-like body 18 in a coupled configuration.

[0098] The actuator 7 moves the carriage 8 in the advancement direction X until the connector 9 is coupled with the further connector 10. The coupling between the connector 9 and the further connector 10 defines the position of the box-like body 18, along the advancement direction X, in the coupling configuration P2. In such a configuration, the position of the box-like body 18 with respect to the support bracket 27 can be modified just enough to adapt the position of the box-like body 18 to that of the first coupling portion 2 and thus of the connector 9. This is made possible, by the elastic elements 26 and also by the compressibility of the vibration-damping element 29, which can be squeezed and whose axial dimension can be reduced.

[0099] The coupling system 1 allows the connector 9 to be coupled to the further connector 10 automatically, without direct operator intervention.

[0100] The centring means and the adapting means make it possible to couple the connector 9 to the further connector 10 even if the position of the further connector 10 differs from the expected one, for example due to the wear of the components moving the movable mould.

[0101] The locking elements 31 allow the connector 9 to be held firmly coupled to the further connector 10 even in the presence of vibrations.

[0102] Furthermore, with a single actuator 7, a plurality of operations can be controlled including:

- Opening the protection panel 4 and the protection element 17, and closing the protection panel 4 and the protection element 17;

- Advancing the guiding walls 23 and the further guiding walls 35 for making it possible to centre the further connector 10 with respect to the connector 9 in the directions Y and Z;
- Locking the box-like body 18 with respect to the casing 5 owing to the locking plates 31.

[0103] This makes the coupling system 1 particularly simple and reliable.

[0104] Finally, the centring means is mechanical centring means, which does not require sensors or other expensive electronic components. This allows to keep the costs of the coupling system 1 low.

Claims

1. A coupling system for coupling an apparatus for supplying energy (AE) and a mould (S) for producing concrete products, such that the apparatus for supplying energy (AE) can supply energy to at least one vibrator fitted to the mould (S), the coupling system (1) comprising a first coupling portion (2) having a connector (9) that is connectable to the apparatus for supplying energy (AE) and a second coupling portion (3) having a further connector (10) that is connectable to the vibrator, an actuator (7) being provided for moving the connector (9) along an advancement direction (X) so as to cause the connector (9) to couple with the further connector (10), and wherein the coupling system (1) further comprises centring means (23, 24, 25, 35, 36, 37) for centring the further connector (10) with respect to the connector (9), the centring means (23, 24, 25, 35, 36, 37) comprising first centring means (23, 24, 25) for centring the further connector (10) with respect to the connector (9) in a first direction (Z) transversely to the advancement direction (X) and second centring means (35, 36, 37) for centring the further connector (10) with respect to the connector (9) in a second direction (Y) transversely to the advancement direction (X), the first direction (Z) being arranged transversely to the second direction (Y).
2. The coupling system according to claim 1, wherein the first centring means (23, 24, 25) are distinct from the second centring means (35, 36, 37).
3. The coupling system according to claim 1 or 2, wherein the advancement direction (X) is a substantially horizontal direction, the first direction (Z) is a substantially vertical direction and the second direction (Y) is a substantially horizontal direction perpendicular to the advancement direction (X).
4. The coupling system according to any preceding claim, wherein the first centring means comprises at least one first guiding element (23) associated with

the first coupling portion (2) and suitable for coupling with at least one first guided component (25) associated with the second coupling portion (3), the second centring means comprising at least one second guiding element (35) associated with the first coupling portion (2) and suitable for coupling with at least one second guided component (37) associated with the second coupling portion (3).

5. The coupling system according to claim 4, wherein the first guiding element (23) has a centring slot (24) and the first guided component comprises a protruding element (25) intended for being received in the centring slot (24), and wherein the second guiding element (35) has a further centring slot (36) and the second guided component comprises a further protruding element (37) intended to be received in the further centring slot (36),
and optionally wherein the centring slot (24) has a dimension in the first direction (Z) that decreases parallel to the advancement direction (X) from the second coupling portion (3) to the first coupling portion (2), the further centring slot (36) optionally having a dimension in the second direction (Y) that decreases parallel to the advancement direction (X) from the second coupling portion (3) to the first coupling portion (2),
6. The coupling system according to any preceding claim, wherein the first coupling portion (3) comprises a carriage (8) connected to the actuator (7) so as to be displaceable by the actuator (7) in the advancement direction (X).
7. The coupling system according to claim 6, as appended to claim 4 or 5, wherein the first guiding element (23) and the second guiding element (35) are fixed relative to the carriage (8).
8. The coupling system according to any preceding claim, wherein the second coupling portion (3) comprises a box-like body (18) that houses the further connector (10) and a support (27) for supporting the box-like body (18), the support (27) being fixable to the mould, and wherein optionally at least one elastic element (26) is interposed between the support (27) and the box-like body (18) in order to confer on the box-like body (18) a certain freedom of movement with respect to the support (27), so as to adapt the position of the box-like body (18) to the position of the connector (9).
9. The coupling system according to claim 8, and further comprising a deformable adapting element (29) interposed between the box-like body (18) and the support (27) and extending along the advancement direction (X), the deformable adapting element (29) being compressible to modify the position of the box-

like body (18) with respect to the support (27) in the advancement direction (X) in an end portion of the stroke of the actuator (7).

10. The coupling system according to claim 9, wherein the second coupling portion (3) further comprises a fixing element (38) that passes through the deformable adapting element (29) and engages with clearance in a hole (28) of the support (27) to connect the box-like body (18) to the support (27).
11. The coupling system according to any preceding claim, and further comprising at least one locking element (31) that is selectively activatable by the actuator (7) to lock the first coupling portion (2) and the second coupling portion (3) in a coupling configuration (P2).
12. The coupling system according to claim 11, wherein the locking element (31) has a hooking opening (30) and can oscillate around an axis for bringing the hooking opening (30) into engagement with a protruding element (25) of the second coupling portion (3).
13. The coupling system according to any preceding claim, wherein the first coupling portion (2) comprises a protection panel (4) that is displaceable between a closed configuration for protecting the connector (9) and an open configuration for enabling the connector (9) to advance towards the further connector in the advancement direction, the protection panel (4) being controlled by the actuator (7).
14. The coupling system according to claim 13, and comprising a cam device for moving the protection panel (4) between the open position and the closed position, the cam device being suitable for acting whilst the actuator (7) moves the connector (9) in the advancement direction (X).
15. The coupling system according to claim 13 or 14, wherein the second coupling portion (3) comprises a protection element (17) that is displaceable between a closed position for protecting the further connector (10) and an open position for enabling the further connector (10) to be accessed, the protection panel (4) being configured to move the protection element (17) from the closed position to the open position whilst the protection panel (4) opens, and optionally wherein a drive protuberance (16) protrudes from the protection panel (4), the drive protuberance (16) being suitable for being positioned below an engagement member (21) supported by the protection element (17) in order to lift the protection element (17) whilst the protection panel (4) opens.

Fig.1

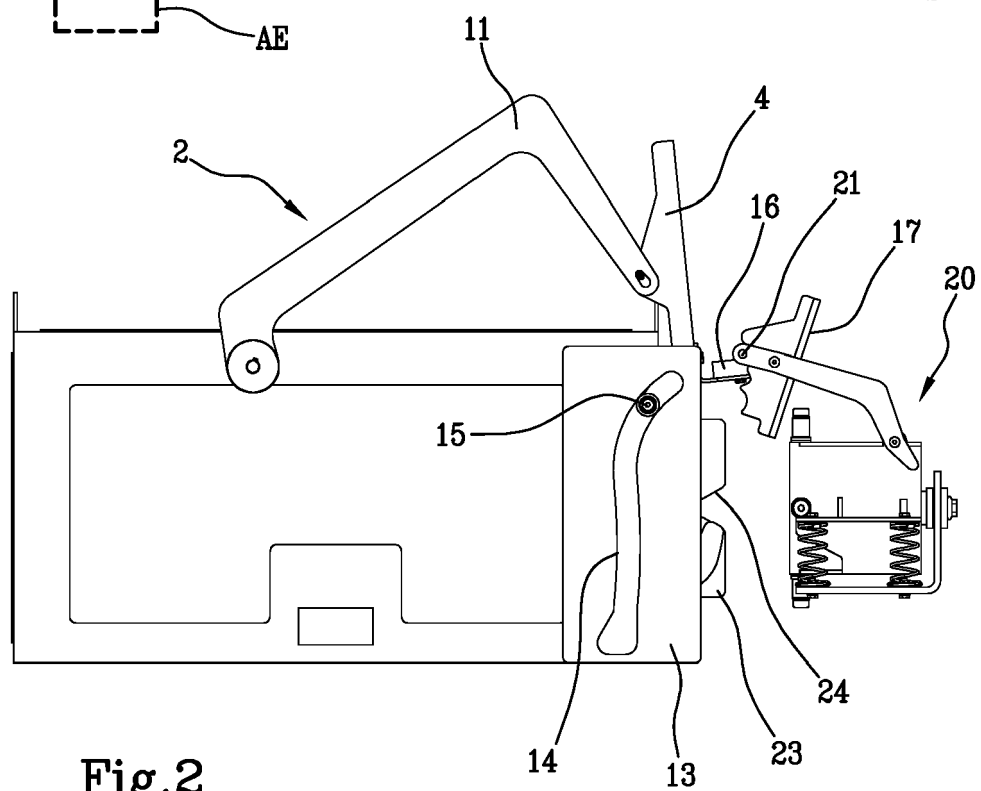
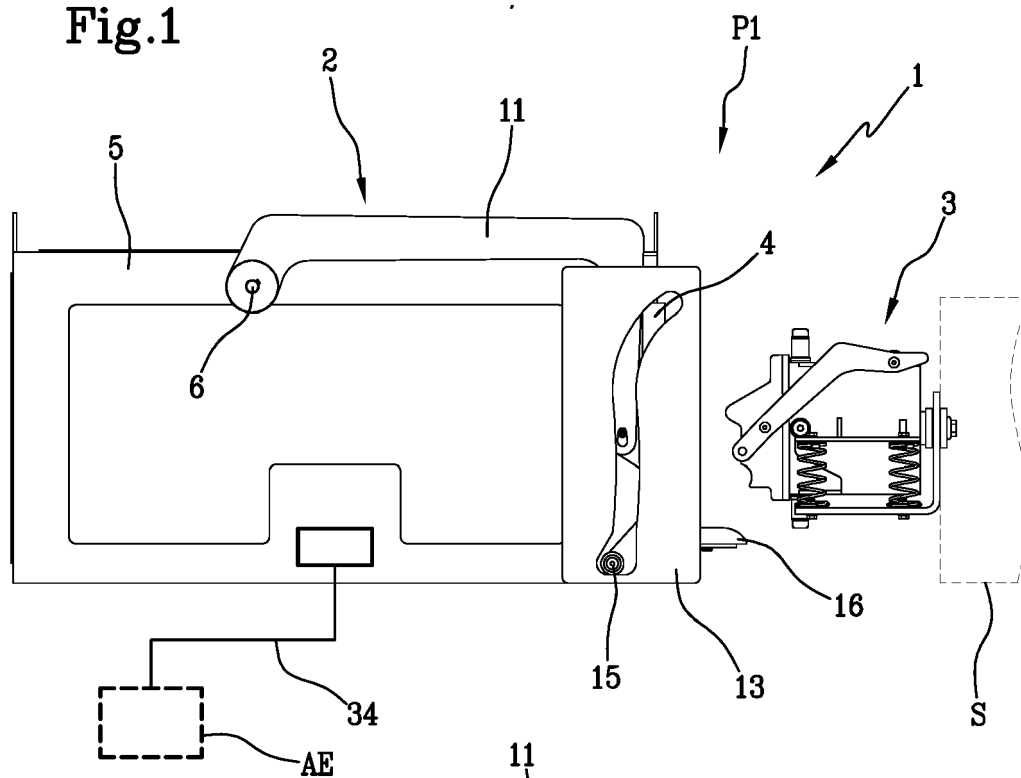


Fig.2

Fig.3

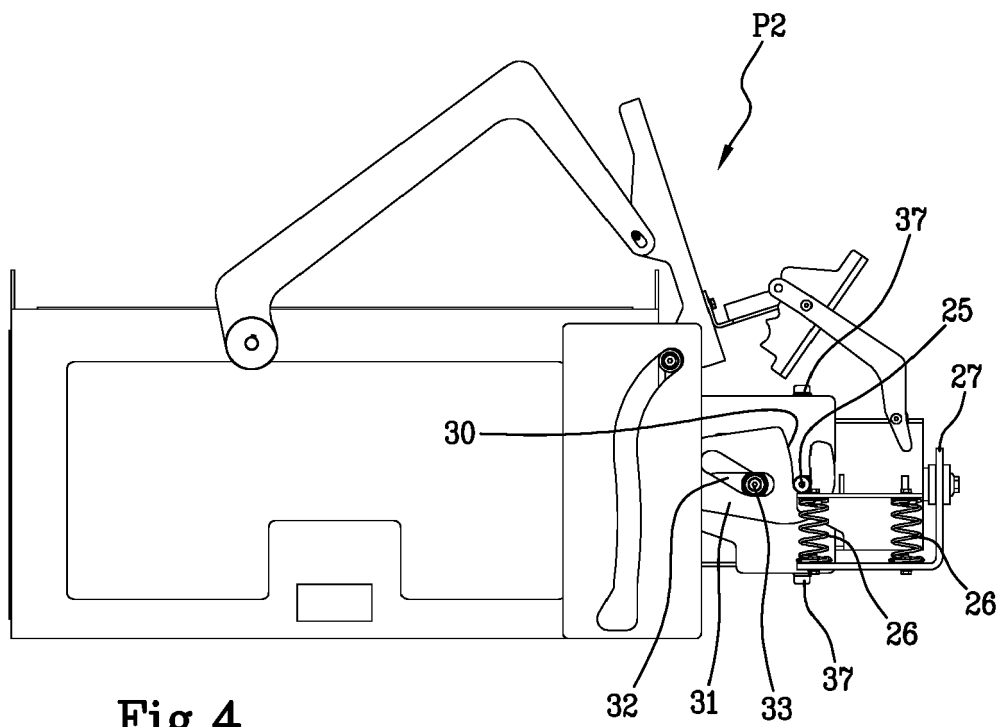
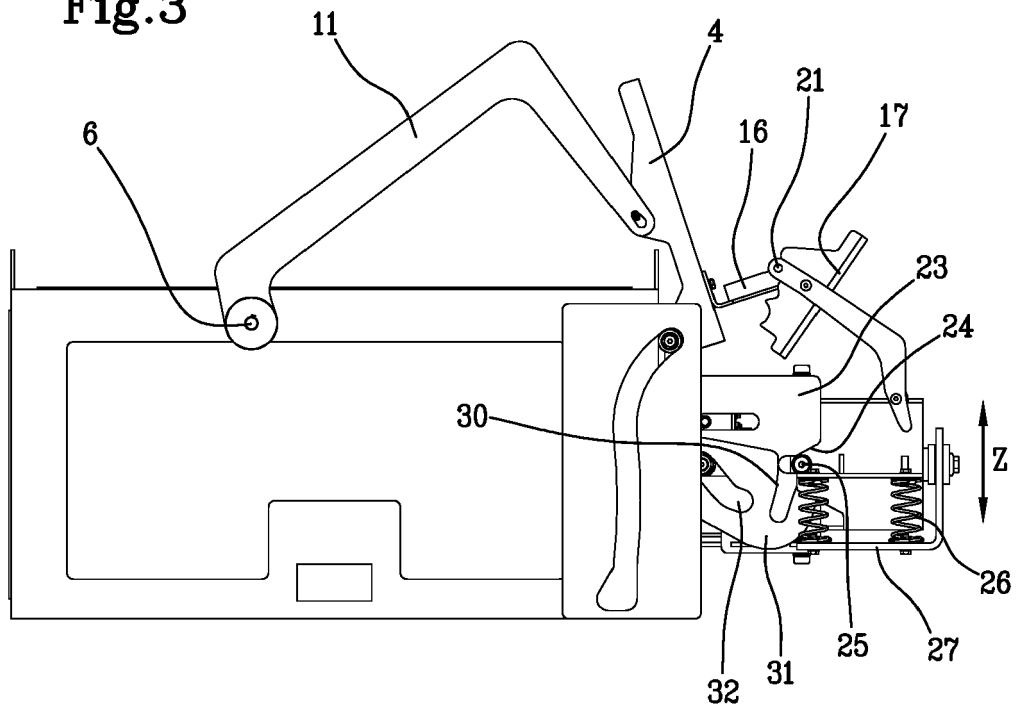


Fig.4

Fig.5

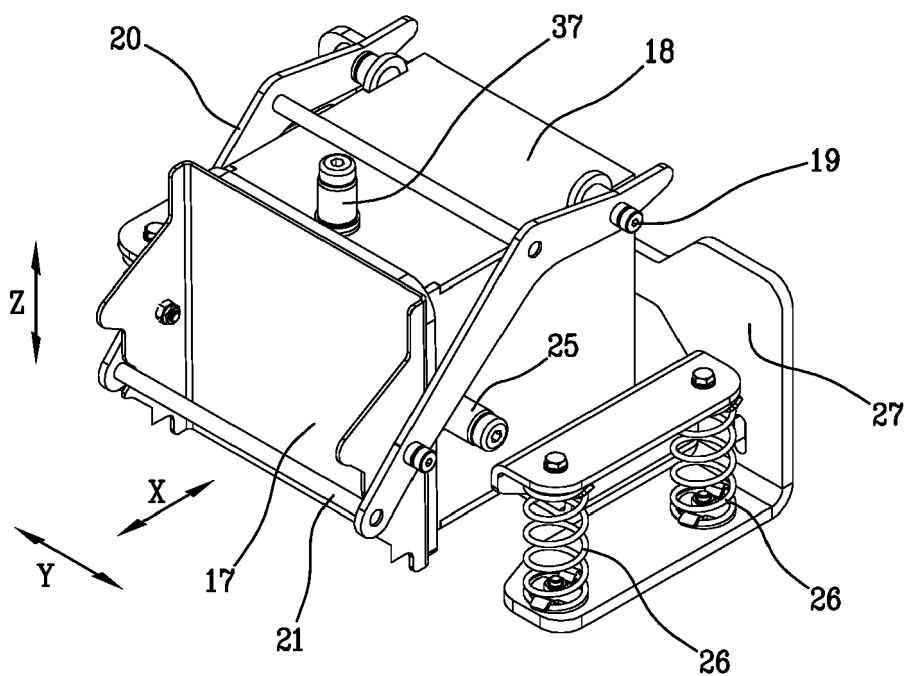
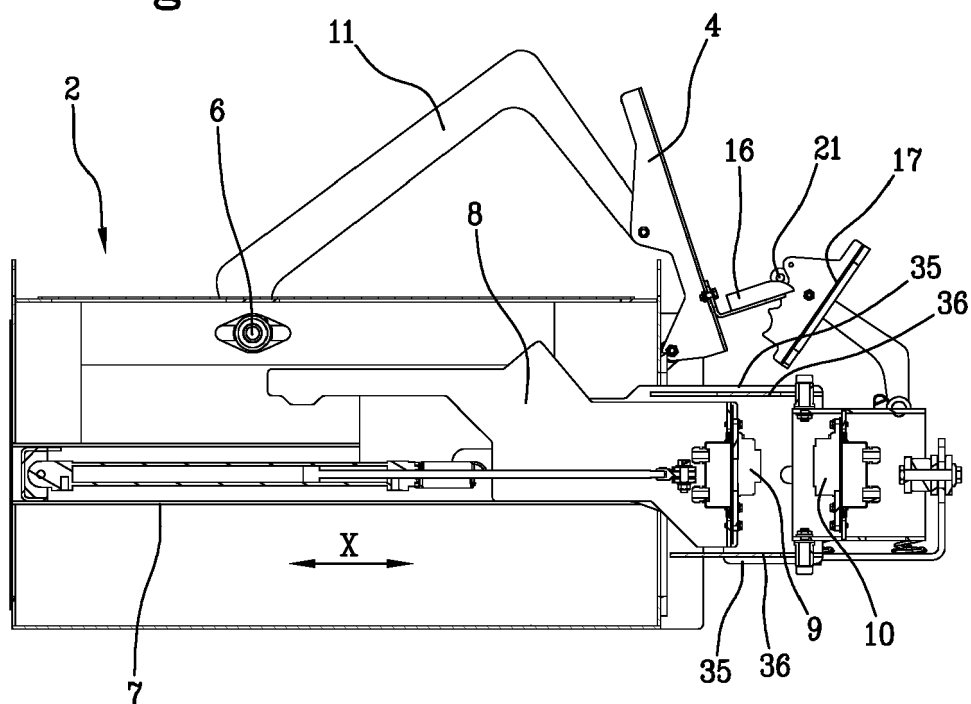


Fig.6

Fig.7

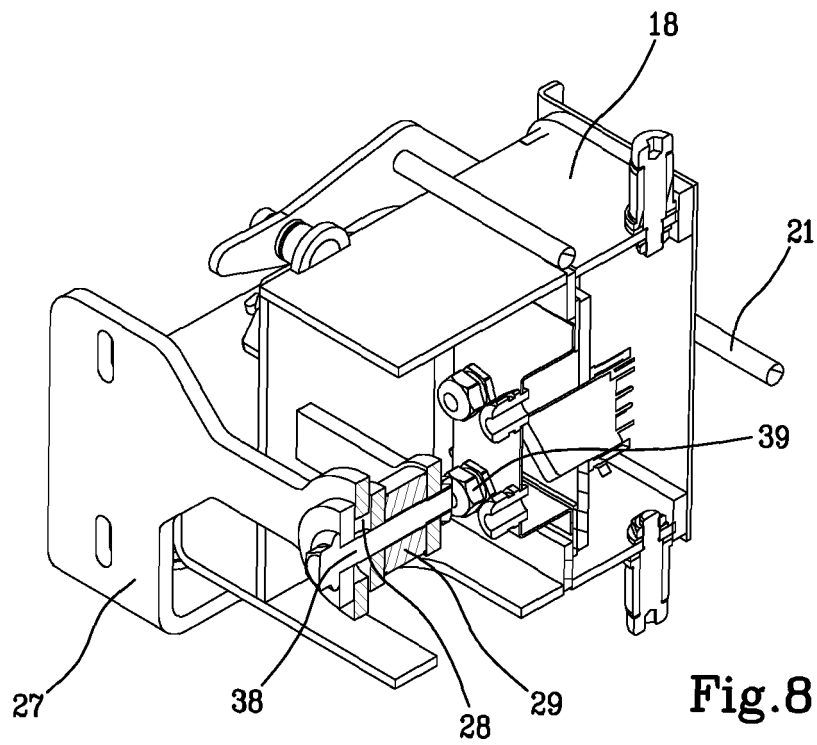
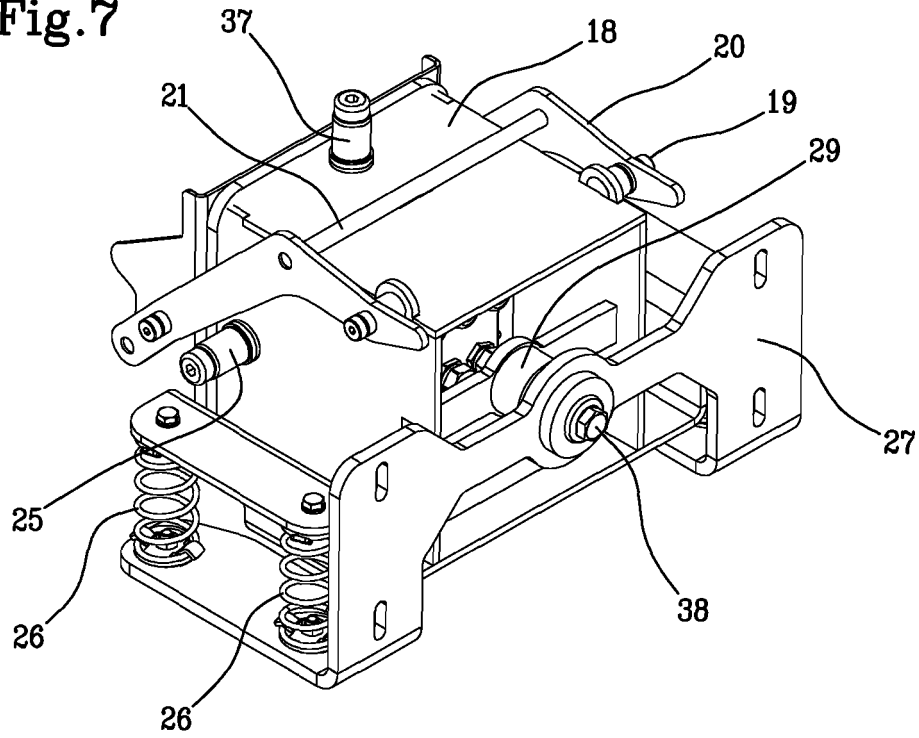


Fig.8



EUROPEAN SEARCH REPORT

Application Number

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	FR 2 956 059 A1 (C B E [FR]) 12 August 2011 (2011-08-12)	1,3,6,8	INV. B28B1/08
A	* page 6, line 8 - page 12, line 20; claims 1-4,7; figures * -----	2,4,5,7, 9-15	B28B5/04
A	US 2014/220172 A1 (KRENTZ DOUGLAS [US]) 7 August 2014 (2014-08-07) * paragraph [0022] - paragraph [0023]; figures * * paragraph [0028] - paragraph [0031] * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B28B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 2 September 2024	Examiner Orij, Jack
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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US 2014220172	A1	07-08-2014	NONE

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82