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(71) Applicants:
• **Hunan Sany Intelligent Control Equipment Co., Ltd**
Hunan 410100 (CN)
• **Sany Heavy Industry Co., Ltd.**
Changsha
Hunan 410100 (CN)

(72) Inventors:
• **LIU, Zhibin**
Hunan 410100 (CN)
• **DENG, Biao**
Hunan 410100 (CN)
• **YI, Xiuming**
Hunan 410100 (CN)
• **WANG, Tao**
Hunan 410100 (CN)

(74) Representative: **Manitz, Finsterwald & Partner**
GbR
Martin-Greif-Strasse 1
80336 München (DE)

(54) **CONCRETE PUMPING STRUCTURE**

(57) A concrete pumping structure comprises a conveying cylinder (1), a water tank (3) and a driving oil cylinder (4). A concrete piston (2) is provided in the conveying cylinder (1). A piston rod (5) of the driving oil cylinder drives the concrete piston to reciprocate in the conveying cylinder (1) when pumping is proceeding. The water tank (3) is located between the conveying cylinder (1) and the driving oil cylinder (4). An auxiliary oil cylinder (7) for returning the piston located at the end of the driving oil cylinder is arranged inside the driving oil cylinder, and a

moveable auxiliary oil cylinder piston (12) is arranged in the auxiliary oil cylinder (7) for returning the piston so as to restrict the piston rod to bring the concrete piston back to water tank when working or allow the piston rod to bring the concrete piston back to water tank when returning the piston. Due to the present invention, not only the concrete piston is convenient to replace, but also the length of the integral pumping mechanism is reduced and therefore the whole structure is compact. Furthermore, the pumping structure can be installed in less space and has lower weight.

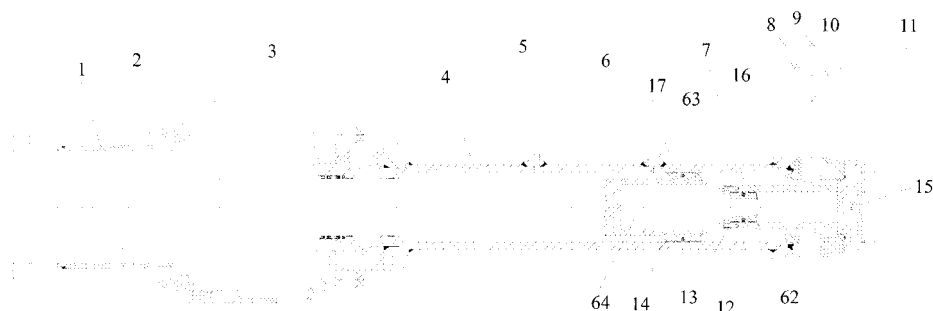


Fig. 3

Description**FIELD OF THE INVENTION**

[0001] The present invention relates to a concrete pumping structure.

BACKGROUND OF THE INVENTION

[0002] In a concrete convey device, a concrete piston is a wearing part and needs to be replaced frequently. Since the concrete piston is entirely in the conveying cylinder in the normal state (operation state), when the concrete piston requires to be replaced, the concrete piston must be returned from the conveying cylinder to the water tank for disassembly, replacement or maintenance.

[0003] At the present, two kinds of pumping structure are commonly used, one is to connect the concrete piston to the piston rod of the driving oil cylinder via an intermediate connection rod, as shown in Fig. 1 (the intermediate connection rod is connected to the piston rod of the driving oil cylinder and the concrete piston by a bolt or a cutting ferrule, the bolt connection is shown). When it is required to disassemble the concrete piston, the intermediate connection rod 2' is removed firstly, then the piston rod 3' of the driving oil cylinder is moved forward by jog operation to approach the concrete piston 1', subsequently the piston rod 3' of the driving oil cylinder is directly coupled to the concrete piston 1', and at last the piston rod 3' of the driving oil cylinder is moved backward by jog operation to make the concrete piston 1' return to the water tank. After disassembly, it is necessary to perform assembly in the reversed sequence of the above process. Therefore, the operation is difficult and needs long time. This affects the concrete pumping operation and device greatly.

[0004] In the second typical structure, the intermediate connection rod is cancelled, and a position limit cylinder which is especially for returning the concrete piston is added at the end of the driving oil cylinder. As shown in Fig. 2, comparing with the first structure, this kind of structure can replace and maintain the concrete piston more easily. The operation principle lies in: the concrete piston 2" is mounted in the conveying cylinder 1" and its rear end is directly coupled to a piston rod 4" of the driving oil cylinder via a cutting ferrule 3" to lengthen the stroke of the driving oil cylinder 6". A position limit piston 8" is used for position limit protection. The rear chamber of the position limit piston cylinder 9" is connected to a pressure oil source via a one-way valve 11" and a reversing valve 12". During normal operation, the pressure oil enters the rear chamber of the position limit piston cylinder 9" through the one-way valve and the reversing valve to push the position limit piston 8" to a front retaining ring 7". Due to locking of the one-way valve 11", the hydraulic oil is not able to flow out from the rear chamber of the position limit piston cylinder 9", so the position limit piston 8" cannot move backward. When the piston rod 4" of the driving oil cylinder contacts to the position limit piston 8", it will be restricted by the position limit piston 8" to keep the concrete piston 2" in the working position. When the concrete piston 2" is needed to be replaced or cleaned, the reversing valve 12" is controlled to reverse so that the position limit piston cylinder 9" is communicated with an oil tank 10" and thereby the hydraulic oil can flow out freely. When the piston rod 4" of the driving oil cylinder is jogged backward, the piston rod 4" of the driving oil cylinder can push the position limit piston 8" backward till the concrete piston 2" returns into the water tank due to without locking of the one-way valve 11". Then the cover of the water tank can be opened to directly wash or replace the concrete piston 2'. After that the cover of the water tank is closed and the reversing valve 12" is controlled to communicate with the pressure oil source. The pressure oil enters the rear chamber of the position limit piston cylinder 9" through the one-way valve 11" and the reversing valve 12" to push the position limit piston 8" to the front retaining ring 7" again. Due to the locking of the one-way valve 11", the hydraulic oil is not able to flow out of the rear chamber of the position limit piston cylinder 9", so that the position limit piston 8" cannot move backward. When the piston rod 4" of the driving oil cylinder contacts to the position limit piston 8", it will be restricted by the position limit piston 8", and the concrete piston 2" is thereby kept in the normal working position again.

[0005] In the above pumping structure for easily replacing the concrete piston, the length and weight of the whole pumping structure are increased because of one auxiliary oil cylinder at the end of the driving oil cylinder and the length of the section of the piston rod 4" of the rear end of the driving oil cylinder abutting against the position limit piston 8", therefore a larger space is required for installation and the weight for the whole vehicle is increased.

SUMMARY OF THE INVENTION

[0006] The present invention provides a new concrete pumping structure for convenient replacement of a concrete piston, which not only enables the concrete piston to be replaced conveniently, but also reduces the length of the integral pumping structure with respect to the prior art and therefore the whole structure is compact and aesthetic. Furthermore, the whole pumping structure has lower weight.

[0007] The object of the present invention is realized through the following solution: a concrete pumping structure comprises a conveying cylinder, a water tank and a driving oil cylinder. The conveying cylinder is provided with a concrete

piston. A piston rod of the driving oil cylinder drives the concrete piston to reciprocate in the conveying cylinder when pumping is proceeding, wherein the water tank is located between the conveying cylinder and the driving oil cylinder. The concrete pumping structure further comprises an auxiliary oil cylinder for returning the piston which is located at the end of the driving oil cylinder and is arranged inside the driving oil cylinder, wherein a moveable auxiliary oil cylinder piston is arranged in the auxiliary oil cylinder for returning the piston, the auxiliary oil cylinder piston lets oil in through an oil inlet of the auxiliary oil cylinder to restrict the concrete piston back into the water tank when working or makes oil return to allow the piston rod to bring the concrete piston back into the water tank when returning the piston.

[0008] Since an auxiliary oil cylinder for returning the piston which is used to return the concrete piston is located inside the end of the driving oil cylinder, it is possible to make the auxiliary oil cylinder for returning the piston take up the space inside the thickening cylinder wall at the end of the current driving oil cylinder so that the length of the connection portion between the auxiliary oil cylinder and the driving oil cylinder is not needed and thereby additional arrangement of the auxiliary oil cylinder for returning the piston does not result in that the length of the whole pumping structure is increased by the length of an auxiliary oil cylinder for returning the piston. Therefore, the increase of the length of the whole pumping structure is greatly less than that in the prior art.

[0009] According to a further improvement solution of the present invention, an opening is established at the rear end of the piston rod of the driving oil cylinder; and the opening is configured as being able to contain the auxiliary oil cylinder for returning the piston; an auxiliary piston rod is arranged between the opening and the auxiliary oil cylinder piston. The piston rod of the driving oil cylinder realizes position limit during operation in such a way that the front end of the auxiliary piston rod abuts against the bottom wall of the opening or the rear end of the auxiliary piston rod abuts against the auxiliary oil cylinder piston. Since the auxiliary oil cylinder for returning the piston is arranged inside the end of the driving oil cylinder as well as since an opening capable of containing the auxiliary oil cylinder for returning the piston is established at the rear end of the piston rod of the driving oil cylinder, it is possible to omit the intermediate connection rod in the traditional pumping structure while the whole pumping structure is not lengthened. Compared with the prior art, the sum of the length of one auxiliary oil cylinder for returning the piston and the length of an intermediate connection part for connecting the auxiliary oil cylinder and the driving oil cylinder is deducted. In the first embodiment of the present invention, the rear end of the auxiliary piston rod is connected to the auxiliary oil cylinder piston. The auxiliary piston rod is receivable in the opening at the rear end of the piston rod of the driving oil cylinder at the working state, and the piston rod of the driving oil cylinder restricts the position in such a way that the front end of auxiliary piston rod abuts against the bottom of the opening at the rear end of the piston rod of the driving oil cylinder and due to the auxiliary oil cylinder for returning the piston located inside the rear end of the driving oil cylinder, when the piston is returned, the piston is returned by an additional stroke for the auxiliary oil cylinder for returning the piston contained in the opening. In the second embodiment of the present invention, the front end of the auxiliary piston rod is connected at the bottom wall of the opening. Therefore in working state, the piston rod of the driving oil cylinder restricts the position during operation in such a way that the rear end of the auxiliary piston rod abuts against the auxiliary oil cylinder piston and when the piston is returned, the piston is returned by an additional stroke for the auxiliary oil cylinder for returning the piston contained in the opening. Thus, compared to the traditional structures, the whole pumping structure will not be lengthened, so that not only the concrete piston is convenient to replace, but also the whole structure is compact. In this case, the space for installing the pumping structure on the vehicle is effectively saved and the whole pumping structure has lower weight. Meantime, the intermediate connection rod in the traditional pumping structure is omitted. Through the addition of an auxiliary oil cylinder for returning the piston, washing or replacement of the concrete piston is realized more conveniently and quickly, a lot of labour and time are saved and thereby work efficiency is improved greatly.

[0010] Preferably, the position of the bottom wall of the opening is closer to the water tank than the piston of the driving cylinder in the axial direction, so that the auxiliary piston rod takes advantage of the space inside the piston rod of the driving cylinder, therefore reduce the length of the whole pumping structure.

[0011] Preferably, the length of the opening equals to one stroke of the auxiliary oil cylinder for returning the piston so as to reduce the length of the whole pumping structure in a simple manner.

[0012] According to the first embodiment of the present invention, the rear end of the auxiliary piston rod is connected to the auxiliary oil cylinder piston, and the piston rod of the driving oil cylinder restricts the position during operation in such a way that the front end of auxiliary piston rod abuts against the bottom wall of the opening. When the piston is returned, the piston is returned by an additional stroke for the auxiliary oil cylinder for returning the piston contained in the opening. Here the word "connection" means "integral connection" or detachable connection. That is to say, in the working state, the pressure oil source is communicated with the rear chamber of the auxiliary oil cylinder for returning the piston via a reversing valve, so that the auxiliary oil cylinder piston is pushed forward to the restricted position and brings the auxiliary piston rod to move to the restricted position (or referred to as working position). Thereby the auxiliary piston rod is able to abut against the bottom wall of the opening at the rear end of the piston rod of the driving oil cylinder to protect it with position restriction. When it is necessary to replace the concrete piston, the rear chamber of the auxiliary oil cylinder for returning the piston is communicated with the oil tank through the reversing valve so that the auxiliary oil cylinder piston loses the function of position restriction, and the piston rod of the driving oil cylinder may push the auxiliary

piston rod and the auxiliary oil cylinder piston to move backward till reaching the rear closure board of the driving oil cylinder so as to return the concrete piston into the water tank.

[0013] In the first embodiment of the present invention, the auxiliary piston rod has a small diameter portion, a middle diameter portion and a big diameter portion, wherein the small diameter portion is suitable for making the auxiliary oil cylinder sleeve on this portion, the middle diameter portion is suitable to insert into the auxiliary oil cylinder body, and a certain gap is made between the big diameter portion and the opening, and the size of this gap is designed to ensure the enough contact area between the auxiliary piston rod and the opening so that the hydraulic oil between the auxiliary piston rod and the opening can escape easily as they approach each other.

[0014] Preferably, the auxiliary oil cylinder piston is sleeved on the small diameter portion of the auxiliary piston rod and the left end is position-restricted via the middle diameter portion and the right end is position-restricted via the retaining ring. The front end of the auxiliary oil cylinder for returning the piston is connected to the end cover of the auxiliary oil cylinder with holes via screw thread or fastening means, and the rear end is welding to the rear closure board of the driving oil cylinder together. In order to connect the auxiliary piston rod and the auxiliary oil cylinder piston, the auxiliary piston rod is configured to have a step structure having at least a middle diameter portion and a small diameter portion, wherein the size of the middle diameter portion matches the diameter of the hole on the end cover of the auxiliary oil cylinder, and the small diameter portion is suitable for making the auxiliary oil cylinder piston sleeve on this portion. More preferably, the auxiliary piston rod further has a big diameter portion, a certain gap is made between the big diameter portion and the opening, and the size of this gap is designed to ensure the enough contact area between the auxiliary piston rod and the opening so that the hydraulic oil between the auxiliary piston rod and the opening can escape easily when they approach each other. The size of the big diameter portion, the middle diameter portion and the small diameter portion is dependent upon the stroke of the auxiliary oil cylinder for returning the piston (this stroke also depends upon the extra stroke for returning the concrete piston into the water tank) as well as the diameter of the piston rod of the driving oil cylinder etc.

[0015] According to an alternative solution of the present invention, the front end of the auxiliary piston rod is connected to the bottom wall of the opening and the function of position-restriction during operation is realized in such a way that the rear end of auxiliary piston rod abuts against the auxiliary oil cylinder piston. When the piston is returned, the piston is returned by an additional stroke for the auxiliary oil cylinder for returning the piston is contained in the opening. Here the word "connection" means "integral connection" or detachable connection. That is to say, in the working state, the pressure oil source is communicated with the rear chamber of the auxiliary oil cylinder for returning the piston through a reversing valve, so that the auxiliary oil cylinder piston is pushed forward to the operation position so as to abut against the auxiliary piston rod to realize the function of position-restriction protection. When it is necessary to replace the concrete piston, the rear chamber of the auxiliary oil cylinder for returning the piston is communicated with the oil tank through the reversing valve so that the auxiliary oil cylinder piston loses the function of position-restriction; when the piston rod of the driving oil cylinder brings the auxiliary piston rod to move backward, the auxiliary oil cylinder piston may be pushed to move backward till reaching the rear closure board of the driving oil cylinder so as to return the concrete piston into the water tank.

[0016] In this alternative solution, a threaded mounting hole is arranged at the bottom wall of the opening. The front end of the auxiliary piston rod is provided with outer threaded portion which is able to be screwed into said threaded mounting hole.

[0017] In each embodiment, the size of the opening is preferably not smaller than the outer diameter of the auxiliary oil cylinder for returning the piston. When the concrete piston is returned, the concrete piston may keep moving backward with the opening of the piston rod of the driving oil cylinder surrounding the outer diameter of the auxiliary oil cylinder for returning the piston.

[0018] Preferably, in one embodiment, the piston rod of the driving oil cylinder is connected to the driving oil cylinder piston by clip key.

[0019] Preferably, in another embodiment, the piston rod of the driving oil cylinder is threaded connected to the driving oil cylinder piston. A threaded locking washer is used for looseness-proof of the piston rod of the driving oil cylinder and the driving oil cylinder piston.

[0020] In particular, the piston rod of the driving oil cylinder and the driving oil cylinder piston are designed in such a way that: the connection portion between the piston rod of the driving oil cylinder and the driving oil cylinder piston is successively configured as a big outer diameter section, a middle outer diameter section and a small outer diameter section on which the outer thread is provided; the driving oil cylinder piston correspondingly has a big inner diameter section, and a small inner diameter section, wherein the big inner diameter section matches the middle outer diameter section, and the inner thread is provided on the inner circumference of the small inner diameter section which matches the outer thread of the small outer diameter section. Preferably, at least one annular groove for mounting seal ring is provided on the middle outer diameter section of the piston rod.

[0021] Preferably, a first mounting groove for mounting seal ring and a second mounting groove for mounting guide belt are provided on the outer circumference of the small inner diameter section.

[0022] Preferably, a seal ring is provided on the outer circumference surface of the auxiliary oil cylinder piston to separate the rear chamber of the driving oil cylinder from the rear chamber of the auxiliary oil cylinder for returning the piston.

[0023] Preferably, the front end of the auxiliary oil cylinder for returning the piston is connected to an end cover of the auxiliary oil cylinder having holes via fastening means, such as screw connection or threaded connection. Or the front end of the cylinder body forms a radially inward step and the rear end is connected to the rear closure board of the driving oil cylinder together. In this case, the oil port of the auxiliary cylinder is arranged inside the rear closure board of the driving oil cylinder so as to realize oil inlet or oil return to the rear chamber through the oil port of the auxiliary cylinder.

[0024] In order to movably arrange the auxiliary oil cylinder piston in the auxiliary oil cylinder for returning the piston so as to realize oil inlet during working state through the oil port of the auxiliary cylinder or to realize oil return when the concrete piston is returned, the oil port of the auxiliary cylinder is connected to the working oil port of the reversing valve, and the oil inlet of the reversing valve is connected to the pressure oil source via one-way valve, and the oil return port thereof is connected to the oil return tank. The reversing valve is preferably a two-position three way valve.

[0025] In a preferable embodiment, the rear end of the auxiliary oil cylinder for returning the piston is connected to the rear closure board of the driving oil cylinder via threaded connection. In particular, the auxiliary oil cylinder for returning the piston includes a big outer diameter section, a middle outer diameter section and a small outer diameter section at the rear end, wherein a mounting groove for seal ring is formed on the big outer diameter section, the middle outer diameter section is a section with threaded, and the small outer diameter section is a section without threaded. The rear closure board is provided with a big inner diameter section, a small inner diameter section with threaded and a small inner diameter section without threaded which correspond to the big outer diameter section, the middle outer diameter section and the small outer diameter section respectively.

[0026] The present invention also relates to a concrete pumping system, which includes two concrete pumping structures as described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 shows the technical solution using an intermediate connection rod in the prior art;

Fig. 2 shows the technical solution without an intermediate connection rod in the prior art;

Fig. 3 schematically shows the first embodiment of the present invention;

Fig. 4 schematically shows the second embodiment of the present invention;

Fig. 5 schematically shows the third embodiment of the present invention;

Fig. 6 schematically shows the auxiliary piston rod shown in Fig. 5;

Fig. 7 schematically shows the piston rod of the driving oil cylinder shown in Fig. 5;

Fig. 8 schematically shows the driving oil cylinder piston shown in Fig. 5;

Fig. 9 schematically shows the auxiliary oil cylinder for returning the piston shown in Fig. 5;

Fig. 10 schematically shows the locking washer shown in Fig. 5.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0028] The first embodiment of the present invention is shown in Fig. 3, wherein the concrete pumping structure comprises a conveying cylinder 1, a concrete piston 2, a water tank 3, a driving oil cylinder 4, a piston rod 5 of the driving oil cylinder, an auxiliary piston rod 6, an auxiliary oil cylinder 7 for returning the piston, an oil tank 8, a one-way valve 9, a reversing valve 10, a rear closure board 11 of the driving oil cylinder, an auxiliary oil cylinder piston 12, and an end cover 13 of the auxiliary oil cylinder. The piston rod 5 of the driving oil cylinder reciprocates under the control of a reversing control means of the concrete pump. Since the key point of the present invention lies in the improvement about the replacement of the concrete piston, it will not be explained in detail how the piston rod 5 of the driving oil cylinder reciprocates under the control of the reversing control means of the concrete pump (not shown) in normal situation.

[0029] In this embodiment, the concrete piston 2 is arranged in the conveying cylinder 1 and its rear end is directly connected to the front end of the piston rod 5 of the driving oil cylinder through locking pieces such as cutting ferrules (or bolts). An opening 14 is provided at the rear end of the piston rod 5 of the driving oil cylinder, and the piston rod 5 of the driving oil cylinder realizes the position restriction in such a way that the front end of the auxiliary oil cylinder piston rod 6 abuts against the bottom of the opening 14. The size of the opening 14 is designed to be capable of containing the auxiliary oil cylinder 7 for returning the piston. Preferably, the size of the opening 14 is designed to be not less than the outer diameter of the auxiliary oil cylinder 7 for returning the piston.

[0030] In this embodiment, the auxiliary oil cylinder 7 for returning the piston is located inside the driving oil cylinder 4, the auxiliary oil cylinder piston 12 is movably arranged in the auxiliary oil cylinder 7 for returning the piston so as to realize oil inlet during working state or oil return when the piston is returned, through the oil port 15 of the auxiliary cylinder. The front end of the auxiliary oil cylinder 7 for returning the piston is assembled with the end cover 13 of the auxiliary oil cylinder via fastening pieces such as bolts, and the rear end thereof is welded to the rear closure board 11 of the driving oil cylinder, and the rear chamber thereof is connected to a pressure oil source through the oil port 15 of the auxiliary cylinder. As shown in figures, the oil port 15 of the auxiliary cylinder is connected to the working oil port of the reversing valve, and the oil inlet of the reversing valve is connected to the pressure oil source via the one-way valve 9, and the oil return port thereof is connected to the oil tank 8.

[0031] The auxiliary piston rod 6 is designed as a step structure having a big diameter portion 64, a middle diameter portion 63 and a small diameter portion 62, wherein there is a certain gap left between the big diameter portion and the opening, so that under the condition of ensuring the enough contact area between the auxiliary piston rod and the opening, the hydraulic oil between the auxiliary piston rod and the opening can flow easily when they approach each other. The middle diameter portion has a size matching the diameter of the hole on the end cover 13 of the auxiliary oil cylinder, and the small diameter portion is suitable for making the auxiliary oil cylinder piston 12 sleeve on this portion. The auxiliary oil cylinder piston 12 is sleeved on the auxiliary piston rod 6, and its left end is subjected to position restriction by means of the step between the middle diameter portion and the small diameter portion, and its right end is subjected to position restriction by means of the retaining ring 16 so that the auxiliary oil cylinder piston 12 can be sleeved on the auxiliary piston rod 6 securely. The auxiliary oil cylinder piston 12 separates the rear chamber of the driving oil cylinder 4 from the rear chamber of the auxiliary oil cylinder 7 for returning the piston and a seal separation between these two rear chambers is realized by means of an additional seal ring arranged on the auxiliary oil cylinder piston 12.

[0032] The working principle of the embodiment is: in normal operation, the pressure oil enters into the rear chamber of the auxiliary oil cylinder 7 for returning the piston through the one-way valve 9 and the reversing valve so that the auxiliary oil cylinder piston 12 is pushed to the end cover 13 of the auxiliary oil cylinder. The hydraulic oil cannot flow out of the rear chamber of the auxiliary oil cylinder 7 for returning the piston due to the locking of the one-way valve 9, therefore the auxiliary oil cylinder piston 12 cannot move backward. As soon as the bottom wall of the opening 14 of the piston rod 5 of the driving oil cylinder contacts the auxiliary piston rod 6, it will be blocked by the auxiliary piston rod 6 to keep the concrete piston 2 in the working position. When the concrete piston 2 is needed to be replaced or cleaned, the reversing valve 10 is controlled to change direction so that the auxiliary oil cylinder 7 for returning the piston is communicated with the oil tank 8 and thereby the hydraulic oil can flow out freely. When the piston rod 5 of the driving oil cylinder is moved backward through jog operation, due to without the locking of the one-way valve 9, the piston rod 5 of the driving oil cylinder pushes the auxiliary piston rod 6 backward and drives the auxiliary oil cylinder piston 12 to move backward till to the front end of the rear closure board 11 of the driving oil cylinder, the opening 14 of the piston rod of the driving oil cylinder may further surround the outer diameter of the auxiliary oil cylinder 7 for returning the piston and the concrete piston 2 returns into the water tank 3. Then the cover of the water tank can be opened in order to directly wash or replace the concrete piston 2. After washing or replacing the concrete piston 2, the cover of the water tank is closed and then the reversing valve 10 is controlled to change direction so that the rear chamber of the auxiliary oil cylinder 7 for returning the piston is communicated with the pressure oil source through the reversing valve 10 and the one-way valve 9. The pressure oil enters into the rear chamber of the auxiliary oil cylinder 7 for returning the piston through the one-way valve 9 and the reversing valve 10 so that the auxiliary oil cylinder piston 12 is again pushed to the end cover 13 of the auxiliary oil cylinder. Due to the locking function of the one-way valve 9, the hydraulic oil is not able to flow out of the rear chamber of the auxiliary oil cylinder 7 for returning the piston, and the auxiliary oil cylinder piston 12 cannot move backward. When the bottom wall of the opening 14 of the piston rod 5 of the driving oil cylinder contacts the front end of the auxiliary piston rod 6, the piston rod 5 is blocked by the auxiliary piston rod 6 to keep the concrete piston 2 in the normal working position once again.

[0033] The second embodiment of the present invention is shown in Fig. 4. The difference between Fig. 4 and Fig. 3 only lies in: the front end of the auxiliary piston rod 6 is connected to the bottom wall of the opening 14, and the rear end thereof pushes the auxiliary oil cylinder piston 12 to move at the piston-return state. Here the word "connection" means detachable connection or "integral connection". In this situation, the size of the opening is greater than the outer diameter of the auxiliary oil cylinder for returning the piston. In this case, when the concrete piston is replaced, the opening of the piston rod of the driving oil cylinder may further surround the outer diameter of the auxiliary oil cylinder for returning the

piston and the piston rod can continue to return to ensure that the concrete piston can return into the water tank smoothly. In this way it is effectively ensured that the length of the whole concrete pumping structure is reduced.

[0034] The corresponding working principle is as follows. In normal operation, the pressure oil enters into the rear chamber of the auxiliary oil cylinder 7 for returning the piston through the one-way valve 9 and the reversing valve so that the auxiliary oil cylinder piston 12 is pushed to the end cover 13 of the auxiliary oil cylinder. The hydraulic oil cannot flow out of the rear chamber of the auxiliary oil cylinder 7 for returning the piston due to the locking of the one-way valve 9, so the auxiliary oil cylinder piston 12 cannot move backward. When the auxiliary piston rod 6 connecting with the piston rod 5 of the driving oil cylinder together contacts the auxiliary oil cylinder piston 12, the piston rod 5 will be blocked by the auxiliary oil cylinder piston 12 to keep the concrete piston 2 in the working position. When the concrete piston 2 is needed to be replaced or cleaned, the reversing valve 10 is controlled to change direction so that auxiliary oil cylinder 7 for returning the piston is communicated with the oil tank 8 and thereby the hydraulic oil can flow out freely. When the piston rod 5 of the driving oil cylinder is moved backward by jog operation, due to without the locking of the one-way valve 9, the piston rod 5 of the driving oil cylinder and the auxiliary piston rod 6 connecting with it move backward together, therefore the auxiliary piston rod 6 drives the auxiliary oil cylinder piston 12 to move backward till to the front end of the rear closure board 11 of the driving oil cylinder, the opening 14 of the piston rod of the driving oil cylinder may further surround the outer diameter of the auxiliary oil cylinder 7 for returning the piston and the piston rod 5 can continue to return to make the concrete piston 2 return into the water tank 3, then the cover of the water tank can be opened to directly wash or replace the concrete piston 2. After washing or replacing the concrete piston 2 is finished, the cover of the water tank is closed and the reversing valve 10 is controlled to change direction so that the rear chamber of the auxiliary oil cylinder 7 for returning the piston is communicated with the pressure oil source through the reversing valve 10 and the one-way valve 9. The pressure oil enters into the rear chamber of the auxiliary oil cylinder 7 for returning the piston through the one-way valve 9 and the reversing valve 10 so that the auxiliary oil cylinder piston 12 is pushed to the end cover 13 of the auxiliary oil cylinder again. Due to the locking of the one-way valve 9, the hydraulic oil is not able to flow out of the rear chamber of the auxiliary oil cylinder 7 for returning the piston, and the auxiliary oil cylinder piston 12 cannot move backward. As soon as the auxiliary piston rod 6 of the piston rod 5 of the driving oil cylinder contacts the auxiliary oil cylinder piston 12, it will be blocked so as to keep the concrete piston 2 in the working position once again.

[0035] It should be noted that in the first and second embodiments of the present invention, the piston rod of the driving oil cylinder is connected to the driving oil cylinder piston by a clip key.

[0036] The third embodiment of the present invention is shown in Fig. 5. The difference between Fig. 5 and Fig. 4 lies in: the front end of the auxiliary piston rod 6 is threaded- connected to the bottom wall of the opening 14. As shown in Fig. 6, a threaded mounting hole 51 is arranged at the bottom wall of the opening 14. The auxiliary piston rod is provided with an outer threaded portion 61 which is able to be screwed into said threaded mounting hole 51. The main body section 61 of the auxiliary piston rod 6 abuts against the auxiliary oil cylinder piston 12. The length of the threaded mounting hole 51 is smaller than the depth of outer threaded portion 61 on the piston rod of the driving oil cylinder, so as to ensure the step at the threaded end of the auxiliary piston rod can contact the bottom of the end hole of the piston rod of the driving oil cylinder when the auxiliary piston rod is screwed; it makes the screwing of the auxiliary piston rod easier to have two planes which are processed symmetrically on the right side.

[0037] Fig. 5 also shows an alternative connection mode between the driving oil cylinder piston 17 and the piston rod 5 of the driving oil cylinder as well as an alternative design for the auxiliary oil cylinder 7 for returning the piston, and an alternative connection mode between the auxiliary oil cylinder 7 for returning the piston and the rear closure board 11 of the driving oil cylinder.

[0038] Referring to Figs. 5, 7 and 8, it can be noted clearly that the alternative connection mode between the driving oil cylinder piston 17 and the piston rod 5 of the driving oil cylinder as well as the corresponding design for the driving oil cylinder piston 17 and the piston rod 5 of the driving oil cylinder. The piston rod 5 of the driving oil cylinder 4 is threaded-connected to the driving oil cylinder piston 17. A thread locking washer 18 is used for looseness-proof of the piston rod 5 of the driving oil cylinder 4 and the driving oil cylinder piston 17. The structures of the piston rod 5 of the driving oil cylinder 4 and the driving oil cylinder piston 17 are as shown in Figs. 7 and 8. The portion on the piston rod 5 of the driving oil cylinder 4 which is connecting with the driving oil cylinder piston 17 is successively configured as a big outer diameter portion 52, a middle outer diameter portion 53 and a small outer diameter portion 54 on which the outer thread 55 is provided; the driving oil cylinder piston 17 correspondingly has a big inner diameter portion 171 and a small inner diameter portion 172, wherein the big inner diameter portion 171 cooperates with the middle outer diameter portion 53, and the inner thread 173 is provided on the inner circumference of the small inner diameter portion 172 to cooperate with the outer thread on the small outer diameter portion 54.

[0039] Referring to Fig. 7, the big outer diameter portion 52 not only serves as position-restrictor to the driving oil cylinder piston, but also can reduce the force subjected by the outer thread 55 in the right direction. The middle outer diameter portion 53 is provided with two grooves for mounting seal rings.

[0040] Referring to Fig. 8, the first mounting groove 173 for mounting a seal ring and the second mounting groove 174 for mounting a guide belt are provided on the outer circumference of the small inner diameter portion 172.

[0041] The structure of the thread locking washer 18 refers to Fig. 10. It takes advantage of the double nuts anti-loosening method to against the loosening of the driving oil cylinder piston. The planes at both sides facilitate the tightening of the thread locking washer 18.

[0042] Fig. 9 schematically shows the auxiliary oil cylinder for returning the piston in Fig. 5. The rear end of the auxiliary oil cylinder 7 for returning the piston is threaded connected to the rear closure board 11 of the driving oil cylinder. The auxiliary oil cylinder 7 for returning the piston includes a big outer diameter section 72, a middle outer diameter section 73 and a small outer diameter section 74 at the rear end, wherein a mounting groove 75 for a seal ring is formed on the big outer diameter section 72, the middle outer diameter section 73 is a section with threaded portion, and the small outer diameter section 74 is a section without threaded portion. The rear closure board 11 of the driving oil cylinder has a cylinder shape and is provided with a big inner diameter section 111, a small inner diameter section 112 with threaded portion and a small inner diameter section 113 without threaded portion which correspond to the big outer diameter section 72, the middle outer diameter section 73 and the small outer diameter section 74 respectively. As an alternative, the rear end of the auxiliary oil cylinder 7 for returning the piston can also be welded to the rear closure board 11 of the driving oil cylinder.

Reference amount

[0043]

1'	concrete piston	2'	intermediate connection rod
3'	piston rod of the driving oil cylinder		
1"	conveying cylinder	2"	concrete piston
3"	cutting ferrule	4"	piston rod of the driving oil cylinder
5"	water tank	6"	driving oil cylinder
7"	front retaining ring	8"	position limited piston
9"	position limit piston cylinder	10"	oil tank
11"	one-way valve	12"	reversing valve
1	conveying cylinder	2	concrete piston
3	water tank	4	driving oil cylinder
5	piston rod of the driving oil cylinder	6	an auxiliary piston rod,
7	auxiliary oil cylinder for returning the piston	8	oil tank
9	one-way valve	10	reversing valve
11	rear closure board of the driving oil cylinder	12	auxiliary oil cylinder piston
13	end cover of the auxiliary oil cylinder	14	opening
15	oil port of the auxiliary cylinder	16	retaining ring
17	driving oil cylinder piston	18	thread locking washer
51	threaded mounting hole	52	big outer diameter section
53	middle outer diameter section	54	small outer diameter section
55	outer thread		
61	outer threaded portion on the piston rod of the driving oil cylinder		
62	small diameter portion	63	middle diameter portion
64	big diameter portion	65	main body section
71	radially inward step	72	big outer diameter section
73	middle outer diameter section	74	small outer diameter section
111	big inner diameter section portion threaded	112	small inner diameter section with
113	small inner diameter section		
171	big inner diameter portion	172	small inner diameter distribute
173	inner thread	174	the second mounting groove

Claims

1. A concrete pumping structure comprising a conveying cylinder (1), a water tank (3) and a driving oil cylinder (4), the conveying cylinder (1) is provided with a concrete piston (2), a piston rod (5) of the driving oil cylinder (4) drives the

concrete piston (2) to reciprocate in the conveying cylinder (1) during pumping process, wherein the water tank (3) is located between the conveying cylinder (1) and the driving oil cylinder (4), **characterized in that**, further comprises an auxiliary oil cylinder (7) for returning the piston, the auxiliary oil cylinder (7) is located inside the driving oil cylinder (4) at the end of the driving oil cylinder (4), and a moveable auxiliary oil cylinder piston (12) is arranged in the auxiliary oil cylinder (7) for returning the piston so as to restrict the piston rod (5) to bring the concrete piston back to the water tank (3) during working or allow the piston rod (5) to bring the concrete piston back to the water tank (3) during returning the concrete piston.

2. The concrete pumping structure according to claim 1, **characterized in that**, an opening (14) is arranged at the rear end of the piston rod (5) of the driving oil cylinder; and the opening (14) is configured as being able to receive the auxiliary oil cylinder (7) for returning the piston; an auxiliary piston rod (6) is arranged between the opening (14) and the auxiliary oil cylinder piston (12).

3. The concrete pumping structure according to claim 2, **characterized in that**, the position of the bottom wall of the opening (14) is closer to the water tank (3) than the driving oil cylinder piston (17) in the axial direction.

4. The concrete pumping structure according to any one of claims 2-3, **characterized in that**, the rear end of the auxiliary piston rod (6) is connected to the auxiliary oil cylinder (12), and the piston rod (5) of the driving oil cylinder restricts the position during working in such a way that the front end of auxiliary piston rod (6) abuts against the bottom wall of the opening (14); the piston is returned by an additional stroke of the auxiliary oil cylinder (7) for returning the piston by receiving the auxiliary oil cylinder (7) for returning the piston in the opening (14) during returning the concrete piston.

5. The concrete pumping structure according to claim 4, **characterized in that**, the auxiliary piston rod (6) has a small diameter portion (62), a middle diameter portion (63) and a big diameter portion (64), the small diameter portion (62) is suitable for making the auxiliary oil cylinder piston (12) sleeve on this small diameter portion, the middle diameter portion (63) is suitable to insert into the auxiliary oil cylinder body, a certain gap is made between the big diameter portion (64) and the opening (14), and the size of this gap is so designed to ensure the enough contact area between the auxiliary piston rod (6) and the opening (14), the hydraulic oil between the auxiliary piston rod and the opening flows easily when the auxiliary piston rod and the opening approach each other; the auxiliary oil cylinder piston (12) is sleeved on the small diameter portion (62) of the auxiliary piston rod (6) with the left end being position-restricted by the middle diameter portion (62) and the right end being position-restricted by the retaining ring (16).

6. The concrete pumping structure according to any one of claims 2-3, **characterized in that**, the front end of the auxiliary piston rod (6) is connected to the bottom wall of the opening (14) and the position is restricted during operation in such a way that the rear end of auxiliary piston rod (6) abuts against the auxiliary oil cylinder piston (12); the concrete piston is returned by an additional stroke of the auxiliary oil cylinder (7) for returning the piston due to the opening (14) receive the auxiliary oil cylinder (7) for returning the piston.

7. The concrete pumping structure according to claim 6, **characterized in that**, a threaded mounting hole (51) is arranged at the bottom wall of the opening (14); the auxiliary piston rod (6) is provided with outer threaded section (61) which is able to be screwed into said threaded mounting hole (51).

8. The concrete pumping structure according to any one of claims 2-3, **characterized in that**, the piston rod (5) of the driving oil cylinder (4) is connected to the driving oil cylinder piston (17) through clip key.

9. The concrete pumping structure according to any one of claims 2-3, **characterized in that**, the piston rod (5) of the driving oil cylinder (4) is threaded connected to the driving oil cylinder piston (17).

10. The concrete pumping structure according to claim 9, **characterized in that**, a thread locking washer (18) is used for looseness-proof of the piston rod (5) of the driving oil cylinder (4) and the driving oil cylinder piston (17).

11. The concrete pumping structure according to claim 10, **characterized in that**, the portion connected to the driving oil cylinder piston (17) on the piston rod (5) of the driving oil cylinder (4) is successively provided with a big outer diameter portion (52), a middle outer diameter portion (53) and a small outer diameter portion (54) on which the outer thread (55) is provided; the driving oil cylinder piston (17) correspondingly has a big inner diameter portion (171) and a small inner diameter portion (172), wherein the big inner diameter portion (171) cooperates with the

middle outer diameter portions (53), and inner thread (173) is provided on the inner circumference of the small inner diameter portion (172) to cooperate with the outer thread on the small outer diameter portion (54).

12. The concrete pumping structure according to claim 11, **characterized in that**, at least one annular groove for mounting seal ring is provided on the middle outer diameter portion (53) of the piston rod (5).

13. The concrete pumping structure according to claim 11, **characterized in that**, a first mounting groove (173) for mounting seal ring and a second mounting groove (174) for mounting guide belt are provided on the outer circumference of the small inner diameter portion (172).

14. The concrete pumping structure according to any one of claims 1-3, **characterized in that**, a seal ring is provided on the outer circumference surface of the auxiliary oil cylinder piston (12) to separate the rear chamber of the driving oil cylinder (4) from the rear chamber of the auxiliary oil cylinder (7) for returning the piston.

15. The concrete pumping structure according to any one of claims 1-3, **characterized in that**, the front end of the cylinder body of the auxiliary oil cylinder (7) for returning the piston is connected to an end cover (13) of the auxiliary oil cylinder with holes, or the front end of the cylinder body forms an radially inward step (71), the rear end is connected to the rear closure board (11) of the driving oil cylinder together.

16. The concrete pumping structure according to any one of claims 1-3, **characterized in that**, the auxiliary oil cylinder piston (12) makes oil in through an oil port (15) of the auxiliary cylinder to restrict the piston rod (5) to bring the concrete piston back to the water tank (3) during working or allow the piston rod (5) to bring the concrete piston back to the water tank (3) during returning the concrete piston.

17. The concrete pumping structure according to claim 16, **characterized in that**, the oil port (15) of the auxiliary cylinder is arranged in the rear closure board (11) of the driving oil cylinder.

18. The concrete pumping structure according to claim 16, **characterized in that**, the oil port (15) of the auxiliary cylinder is connected to the working oil port of the reversing valve, and the oil inlet of the reversing valve is connected to the pressure oil source via one-way valve (9), and the oil return port thereof is connected to the oil return tank (8).

19. The concrete pumping structure according to claim 15, **characterized in that**, the rear end of the auxiliary oil cylinder (7) for returning the piston is threaded connected to the rear closure board (11) of the driving oil cylinder.

20. The concrete pumping structure according to claim 19, **characterized in that**, the auxiliary oil cylinder (7) for returning the piston includes a big outer diameter section (72), a middle outer diameter section (73) and a small outer diameter section (74) at the rear end, wherein a mounting groove (75) for seal ring is formed on the big outer diameter section (72), the middle outer diameter section (73) is a section with thread, and the small outer diameter section (74) is a section without thread; the rear closure board (11) is provided with a big inner diameter section (111), a small inner diameter section (112) with thread and a small inner diameter section (113) without thread which correspond to the big outer diameter section (72), the middle outer diameter section (73) and the small outer diameter section (74) respectively.

21. A concrete pumping system, comprising two concrete pumping structures according to any one of claims 1-20.

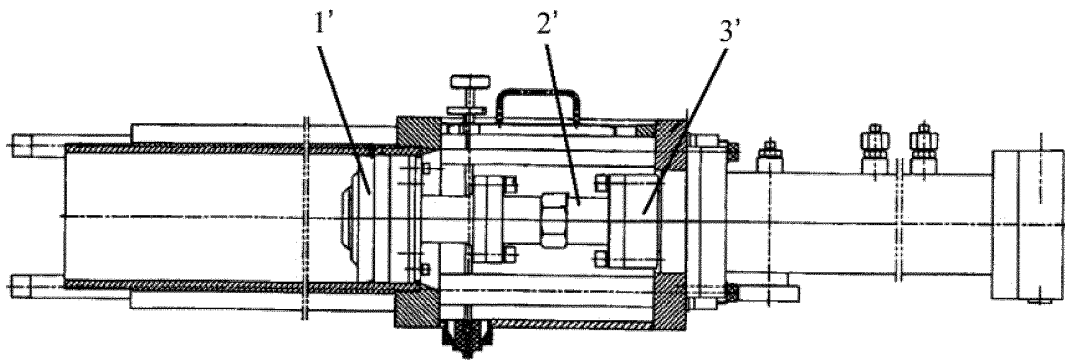


Fig. 1

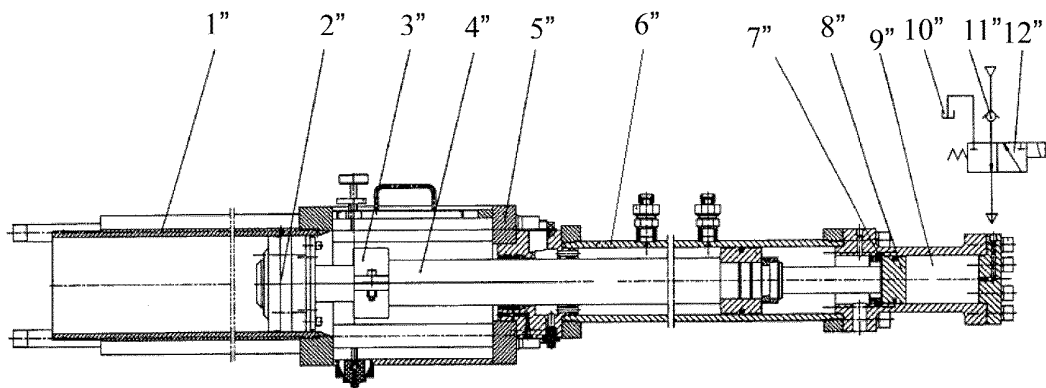


Fig. 2

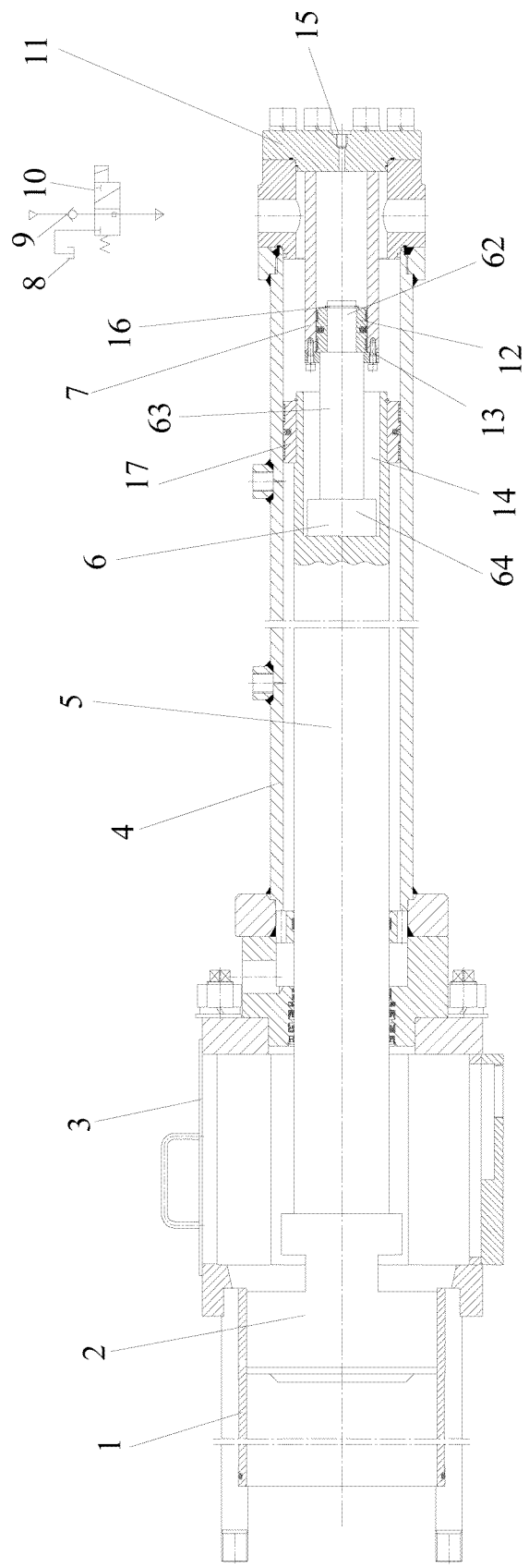


Fig. 3

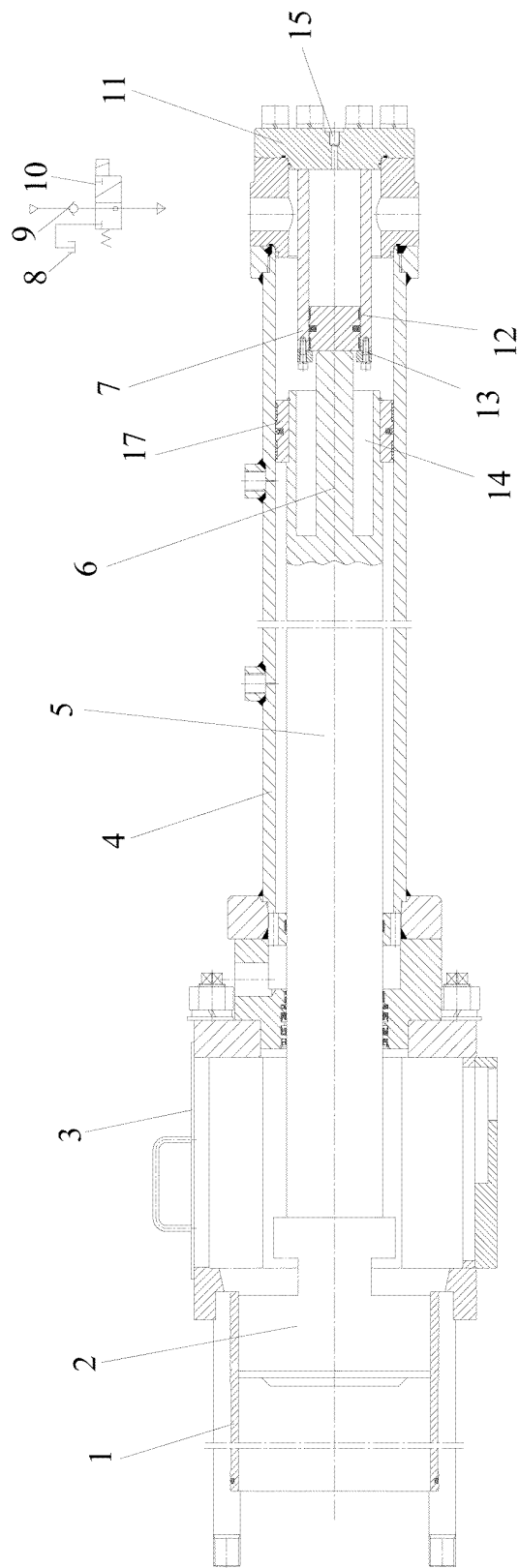


Fig. 4

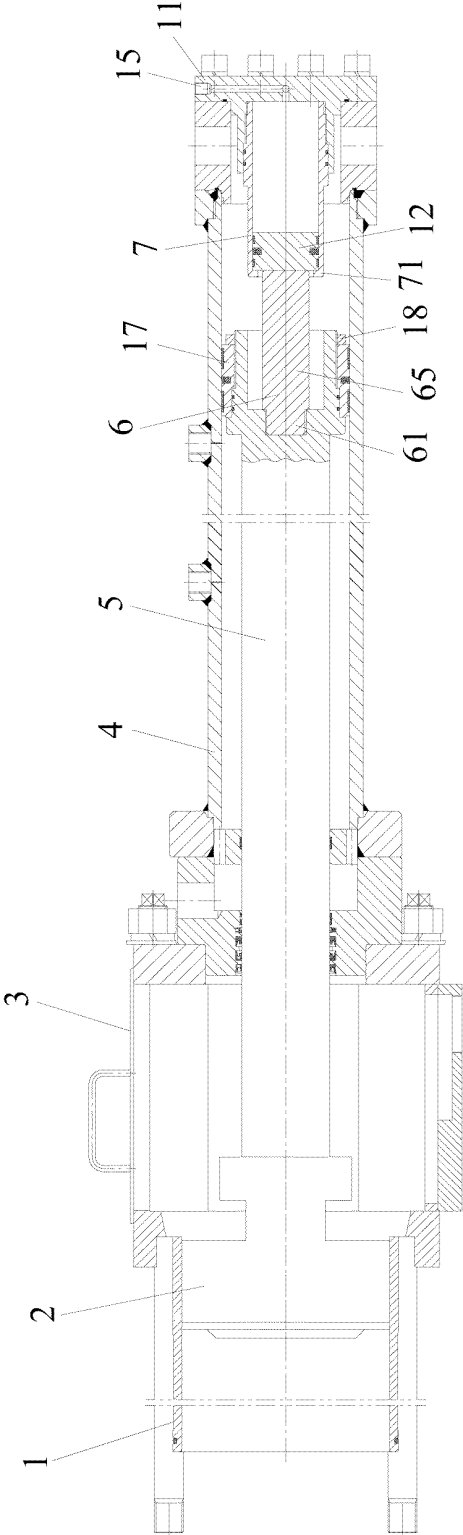


Fig. 5

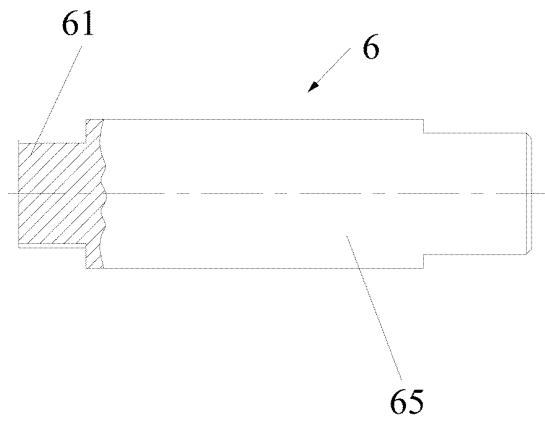


Fig. 6

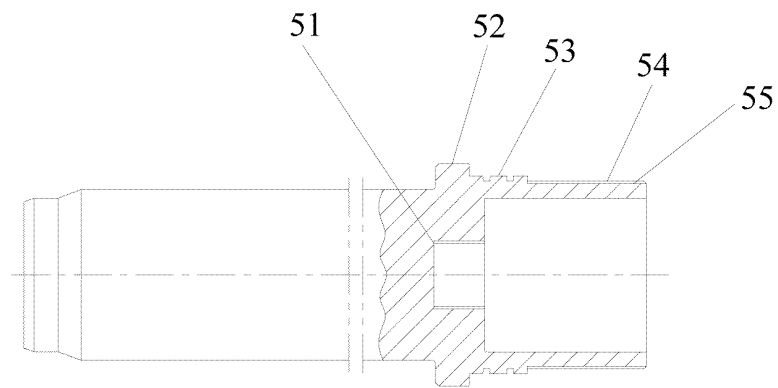


Fig. 7

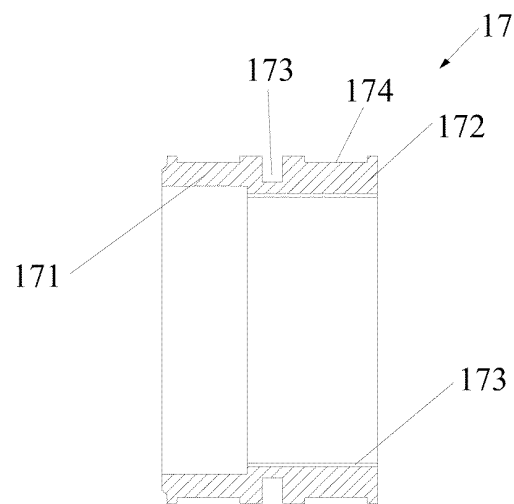


Fig. 8

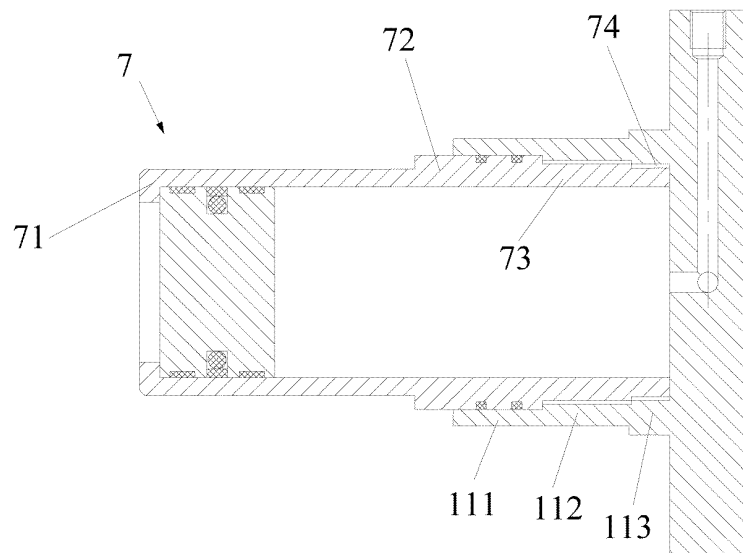


Fig. 9

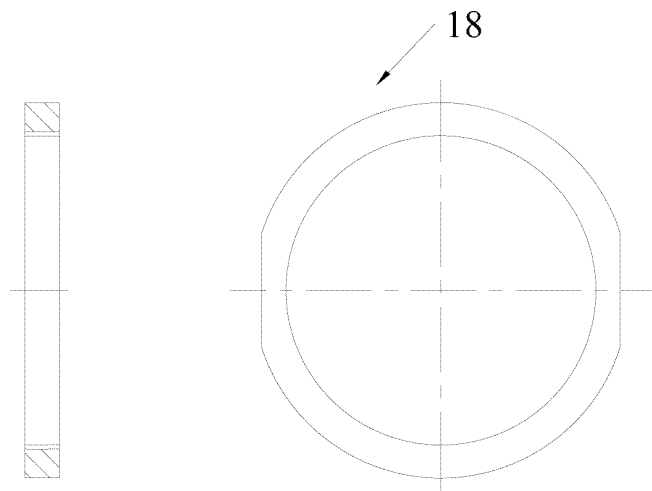


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2010/074862

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: F04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, WPI, CNPAT: concrete, pump, piston, valve, cylinder, hydraulic, auxiliary, piston/plunger, length, retrieve/retract+, water box, assembl+, compact, inner/outer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	CN101705928A (BEIQI FUTIAN AUTOMOBILE CO LTD) 12 May 2010 (12.05.2010) see figure 6	1, 21
P, X	CN201486790U (FOTON LOVOL HEAVY MACHINERY CO LTD) 26 May 2010 (26.05.2010) see figure 1	1, 21
A	CN2526541Y (THREE ONE HEAVY INDUSTRY CO LT) 18 Dec. 2002 (18.12.2002) see the whole document	1-21
A	CN2881144Y (ZHONGJI VEHICLE GROUP CO LTD) 21 Mar. 2007 (21.03.2007) see the whole document	1-21

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

16 Aug. 2010 (16.08.2010)

Date of mailing of the international search report

23 Dec. 2010 (23.12.2010)

Name and mailing address of the ISA/CN
The State Intellectual Property Office, the P.R.China
6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China
100088
Facsimile No. 86-10-62019451

Authorized officer

CHEN, Lili

Telephone No. (86-10)62085258

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2010/074862

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA /210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2010/074862

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Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2010/074862

Continuation of: second sheet

A. CLASSIFICATION OF SUBJECT MATTER

F04B 9/105 (2006.01) i

F04B 15/02 (2006.01) i